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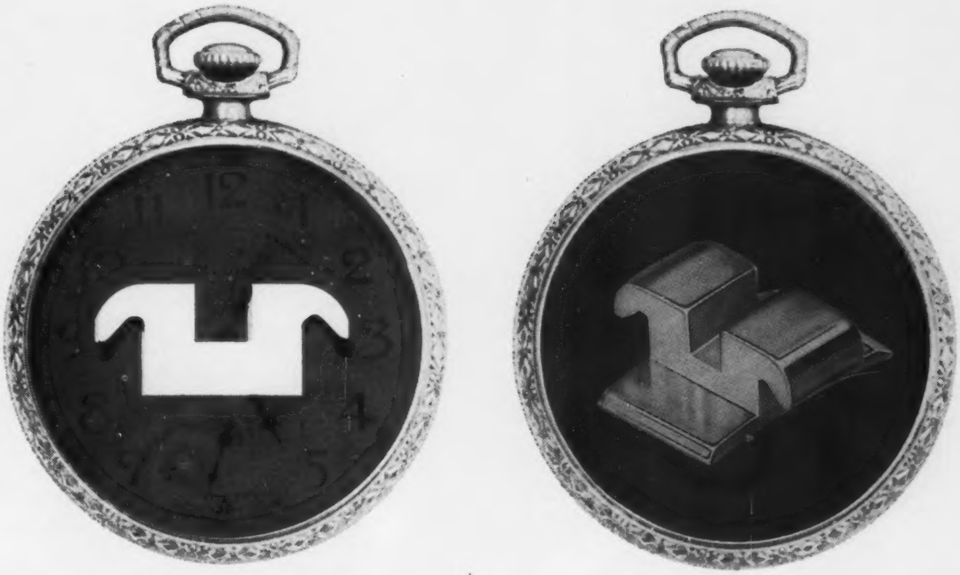

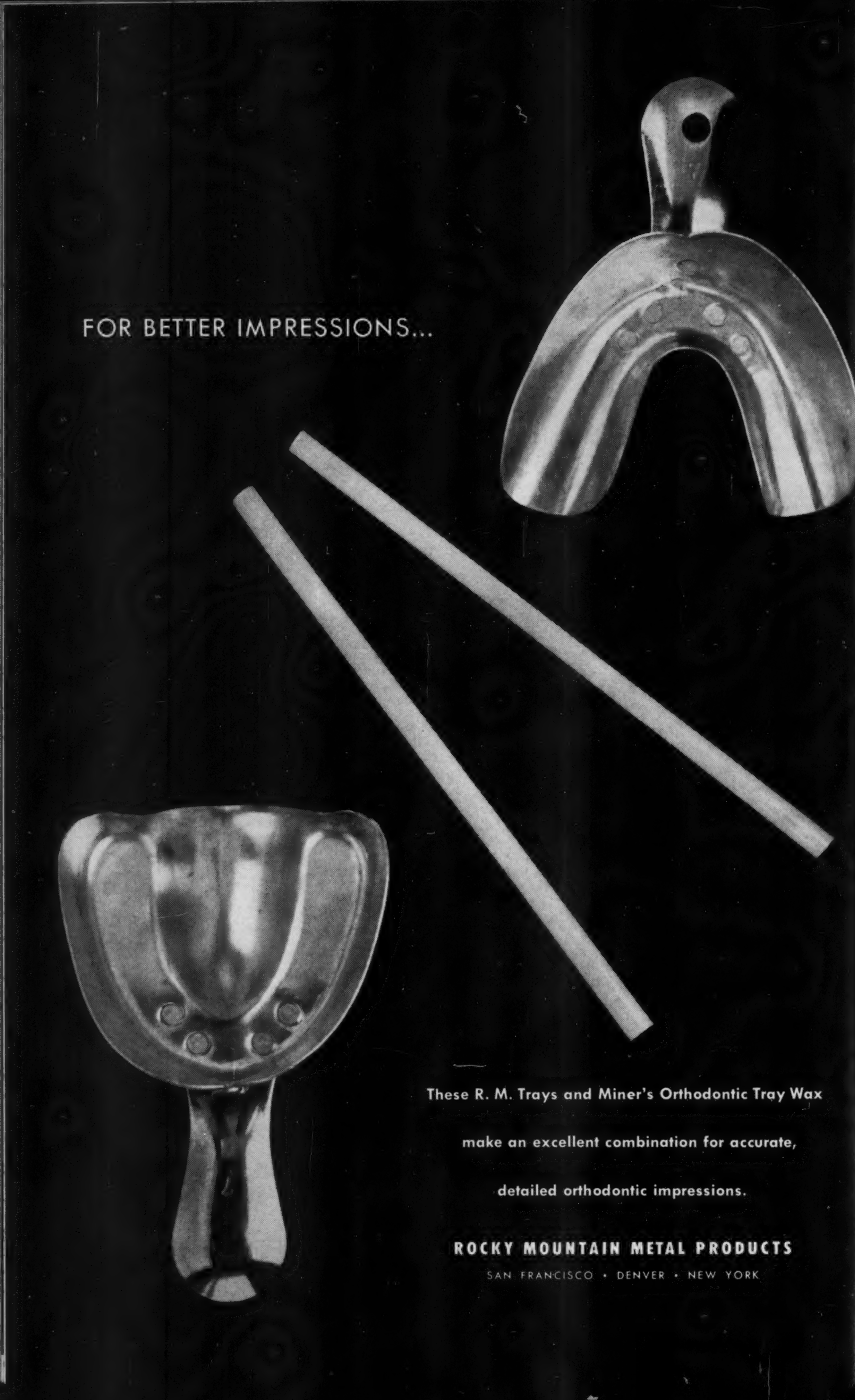
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American Journal *of* ORTHODONTICS

VOL. 43 JULY, 1957 No. 7

Original Articles

POSITION OF THE MAXILLARY FIRST PERMANENT MOLAR IN THE CEPHALOFACIAL COMPLEX

A STUDY IN THREE DIMENSIONS

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> Diagnosis in orthodontia, of course, precedes and is entirely distinct from treatment, yet it is of equal and, if possible, greater importance, for it must govern each and every step that follows.
>
> —*E. H. Angle*[2]

IN THE field of orthodontic research there are, among other problems, two very important themes, the first centering around the relative stability of the upper first permanent molar (written as 6) and the second attempting a degree of correlation between the lateral and the posteroanterior (written as P-A) x-ray films of the head. In essence, the problem of the position of 6 covers both of these themes—in the lateral x-ray film the anteroposterior relationships of this tooth can be studied and in the P-A x-ray film the transverse relationships of this tooth can be studied.

In the present investigation two problems will be tackled: (1) To establish the position of 6 in three planes of space—sagittally or anteroposteriorly, transversely or linguobuccally, vertically or superoinferiorly. I plan to

This thesis was submitted in June, 1956, to the faculty of the Graduate School of Medicine of the University of Pennsylvania in partial fulfillment of requirements for the degree of Master of Science in Dentistry.

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* Diplomé de la Faculté de Médecine de Paris.

relate 6 not only to the other teeth in the maxillary arch, but also to certain craniofacial landmarks and/or structures. (2) To present an analysis of faciodental relationships as seen in the P-A x-ray film and to develop a method of orienting the lateral and P-A x-ray films to one another when taken under identical and controlled conditions on the same subject.

REVIEW OF THE LITERATURE

The importance of the maxillary first permanent molar for classification and diagnosis of malocclusion was strikingly brought to light by Angle.[2] Later, his classification (basically an anteroposterior one) was refined by Dewey[12]; Lischer[27] added the vertical and transversal components.

Hellman[15] defined the minute intercuspid relationships and their variability.

Zsigmondy[31] and later Atkinson[3] correlated the position of the maxillary first permanent molar with the key ridge. Broadbent[6] and Oppenheim[25] disproved the rigidity of such a correlation. Brodie[9] found the maxillary first permanent molar to be situated on the Y axis (S-Gn). Wylie[30] defined its anteroposterior position as related to S, Ptm. fissure, and ANS.

Hellman[16] found the first permanent molar to be normal in position in Class II, Division 1 and forward in Class II, Division 2. Oppenheim[25] found it to be mesial in position in Class II, Division 1 when compared to normal occlusion. Baldridge[4] found its position to be stable after full occlusal contact. Renfroe[26] found it to bear the same relationship to the cranium in Class II, Division 1 and Class II, Division 2 and to be slightly more posterior in Class II than in Class I. Henry[18] found a great percentage of rotation of the first molar in malocclusion cases.

Moorrees[24] defined its position vertically and anteroposteriorly by the mesh method; he found a higher variability anteroposteriorly than vertically. Johnson[20] found a positive correlation between the slope of the mandible and the vertical dimensions of the face.

Concerning its transverse position, Berger[5] and Izard[19] found a positive correlation between the bizygomatic breadth and the bimolar diameter. Meredith and Higley[23] and Henriques[17] did not find this correlation to hold in longitudinal studies.

Concerning the study of the frontal x-ray film (P-A), Harvold[14] assessed asymmetry, using the fronto-orbital sutures for the horizontal plane, while Subtelny[29] used the foramen rotudum (via laminagraphy). Margolis[27] studied the growth of the face on frontal x-rays.

Concerning the study of the head in the three planes of space, Hellman[27] used cephalometric measurements and set a series of averages and standard deviations for each dental age category.

The best studies done with roentgenographic cephalometry in the three planes of space are those of Broadbent[7] and DeCoster.[11] Both offered average dentofacial diagrams for certain age groups; Broadbent used the chronological age and DeCoster used the skeletal age.

Northwestern University is currently undertaking a study on stereocephalometric roentgenography.

It should be added here that at the Philadelphia Center for Research in Child Growth cephalometric standards à la Hellman have been calculated for the Philadelphia population.[21a, 21b] This, with the lateral and posteroanterior x-ray films and the dental casts, constitutes the routine survey of the cephalo-facio-dental evaluation in the three planes of space of every orthodontic patient.

MATERIAL

In this investigation we have used, for each case, the lateral and the frontal (P-A) x-ray films of the head, taken with the Broadbent-Bolton roentgenographic cephalometer. The use of this apparatus is mandatory in conducting a survey such as this, as it is the only technique in which there is a minimum amount of change in the position of the head during the successive lateral and P-A films. It is the only one which allows a serial comparison of the head in three planes.

In each case, the dental cast, taken with alginate and reproduced with Albastone, was used.

SOURCE

The sample was selected from the record files and the dental laboratory of the Philadelphia Center for Research in Child Growth. The total control sample at the Growth Center comprises 600 children selected for a longitudinal study of their growth. They are Caucasian, mostly of Mediterranean (South European) origin. They were originally selected on the basis of "normal" medical and dental health.

In this sample there are, of course, children with normal occlusion and with malocclusion. The dental age ranges from III A to IV C (beginning of eruption of permanent teeth to beginning of $\frac{8 \mid 8}{8 \mid 8}$ eruption).

SAMPLE

It is from this group that the sample of the present study has been selected.

A total of 102 children have been studied. They are all approximately the same dental age. The basic idea was to study children with a complete set of permanent teeth, including the first permanent molar, entirely erupted. Generally, this condition is fulfilled at the III C or early IV A Hellman dental age. The chronological age of this sample was found to range from 11 years 3 months to 13 years 7 months. Nine adults have been included as a test group.

It should be stated that some children have unduly retained second deciduous molars. Those cases will be discussed in a later section.

This total sample comprises the following groups:

1. Normal occlusion
   24 boys
   29 girls
2. Angle Class II, Division 1 malocclusion
   29 cases, male and female

3. Angle Class III malocclusion
   11 cases, male and female
4. Negro, normal occlusion, III C dental age only
   9 cases, male and female
5. Adults, mixed occlusion, male and female
   9 cases

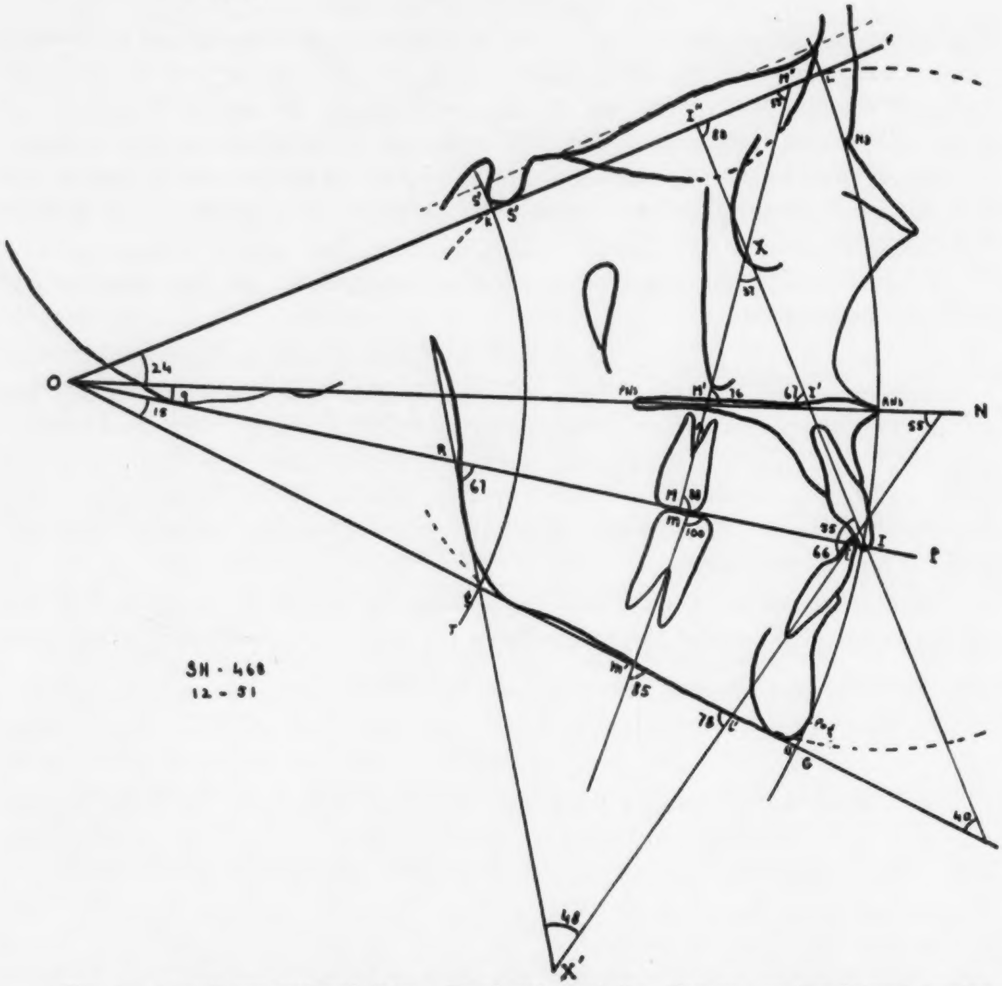


Fig. 1.—A well-proportioned face. Construction of the diagram on the lateral tracing. *s'LO* = Parallel to supraorbital plane, *ANS-PNS-O* = Palatal plane, *-O* = Occlusal plane, *G-g-O* = Mandibular plane. (From Sassouni: Am. J. Orthodontics, October, 1955.)

The main comparative study is between the normal sample and the Class II, Division 1 sample, but it was felt that small samples of Class III Caucasian adults and of Negroes would help test the method of evaluation and give rise to further suggestions. They do not represent samples large enough for statistical evaluation.

Our next aim is to find the ways in which a malocclusion differs from a normal occlusion. What are the different factors which, when present together, create a malocclusion? Therefore, I shall attempt to define a normal occlusion.

The sample of cases with normal occlusion is probably a random one for that particular dental age, since *all* the cases with normal occlusion found in the Center's files are included. Some cases have been rejected only when the x-ray films were poor or if the teeth were not in centric position.

LANDMARKS USED IN THIS STUDY

A. Lateral X-ray Film.—A basic construction was done as described in detail in a previous study.[28] In essence, this consists of drawing (Fig. 1):

1. *Four horizontal planes:* A supraorbital plane (anterior clinoid to tangent to the roof of the orbit) and then a parallel to it through the lower border of sella turcica; the palatal plane (ANS-PNS); the occlusal plane (Downs[13]); and the mandibular plane (Downs[13]).
2. *Two arcs:* From the point of intersection "O" of the four planes as a center are drawn an anterior arc passing through Na, ANS, tip of $\underline{1}$, and Pog and a posterior arc passing through the posterior border of sella turcica and gonion.
3. The vertical balance of the face was assessed between the parallel to the supraorbital plane and the mandibular plane, with the palatal plane as reference.

In addition, the following points have been used (Fig. 2):

Point A or subnasale (Downs).

Point B or supramentale (Downs).

Temporale (Te): Point of intersection between the maxillo-zygomatico-frontal sulcus and the cribriform plate.

Basion (Ba): Lowermost point on the anterior margin of the foramen magnum in the midsagittal plane (Martin[22]).

Opisthion (Op): Most posterior point on the margin of the foramen magnum in the midsagittal plane (Martin[22]).

Bolton point (Bo): Uppermost point in the contour of the retrocondylar fossa (Broadbent[8]).

Odontoidale (Od): Uppermost point of the odontoid process of the axis (second cervical vertebrae).

B. Posteroanterior (P-A) X-ray Film (Fig. 3).—

Latero-orbitale (Lo): The intersecting point between the external orbital contour laterally and the oblique line.

Oblique orbital line: Partly the projection of the greater wing of the sphenoid and partly the frontal bone.

Malare (M): The midpoint of intersection between the projection of the coronoid process and the lower contour of the malar bone. This point is very close to the maxillomalar suture, which cannot be located.

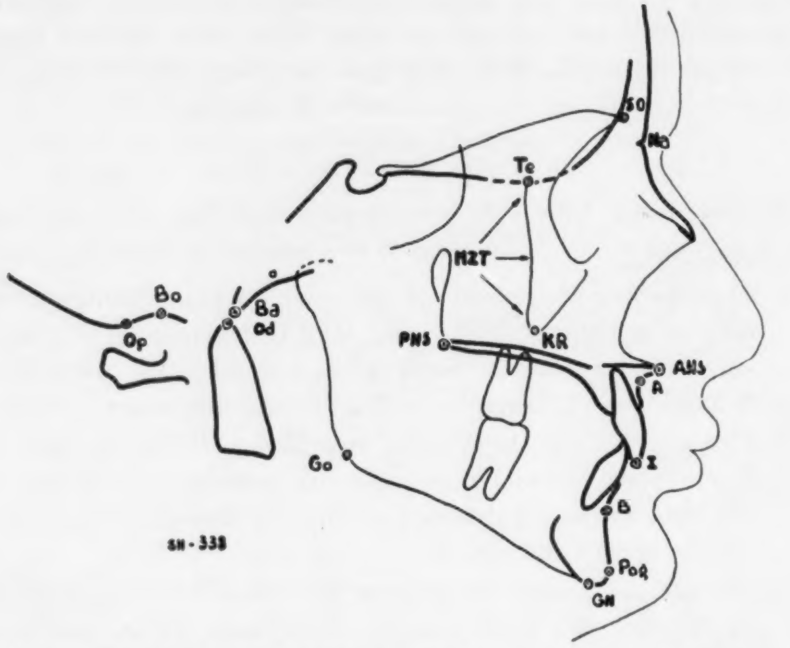


Fig. 2.—Landmarks used on the lateral tracing. *So* = Supraorbital margin, *A* = Subnasale, *B* = Supramentale, *Te* = Temporale, *MXT* = Maxillo-zygo-temporal sulcus, *KR* = Key ridge, *Ba* = Basion, *Od* = Odontoidale, *Bo* = Bolton point, *Op* = Opisthion.

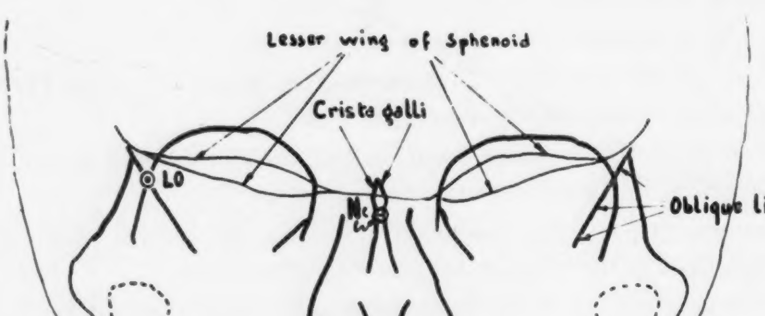


Fig. 3.—Landmarks on the posteroanterior tracing. *Lo* = Latero-orbitale, *Nc* = Neck of crista galli, *Ms* = Mastoidale, *M* = Malare, *Mx* = Maxillare, *Od* = Odontoidale.

Maxillare (Mx): Maximum concavity on the contour of the maxilla between the first molar and malare.

Mastoidale (Ms): Lowest point of the contour of the mastoid bone as seen on the P-A film.

Gonion (Go): (1) *In the lateral film,* the point of intersection of the gonial contour and the bisectrix of the angle formed by the ramal and the mandibular planes. (2) *In the P-A film,* the lateral and P-A tracing should first be positioned on a millimeter grid. Gonion on the P-A tracing is then taken as the projection horizontally of the gonion from the lateral tracing. This gives the vertical level. Then Go is located 2 mm. inside the lateral contour of the mandible. (The average thickness of the mandible at gonion is about 4 mm.)

Nc: Neck of perpendicular lamina of the ethmoid.

On the tracing, the Frankfort horizontal used is the plane connecting the center of the earrods to orbitale (lowermost point in the orbital contour).

MEASUREMENTS

This study is divided into four chapters. The first three are analytical, one devoted to each plane of space, and the fourth is a synthesis of the first three.

To facilitate the reading, the measurements (linear, angular, or positional) pertaining to each category have been defined at the beginning of the corresponding chapter.

METHOD AND CONCEPTS

Technique of Correlating the Lateral and the P-A X-ray Films.—It is almost impossible with any cephalostat to orient the head in exactly the same planes (FH) each successive time that a patient is seen. This is due to the fact that the holding devices rest on soft tissue. Following are some of the major difficulties which limit the use of the lateral and P-A films.

Lateral film: When only the lateral film is used, the orientation is relatively easy, even if there has been some malpositioning of the head.

1. If there is some asymmetry or if the head has been slightly tilted laterally (and therefore if the two sides of the face do not superimpose on the film), according to the Björk technique, the midpoint and midline are taken between the two contours.
2. If the face is tilted anteriorly downward or upward, the Frankfort horizontal can be re-established.

P-A film: In the P-A x-ray film the reorientation is more difficult, if not impossible, when the different depths of the facial structures are considered.

1. If the face was tilted on one side, but the midsagittal plane was perpendicular to the film, it is easy to re-establish the real Frankfort horizontal.

2. If the face was tilted downward or upward relative to the FH, it is impossible to re-establish the face in the FH.
3. If the face was turned laterally (in other words, if the midsagittal plane was not perpendicular to the film), it is impossible to re-establish the face in its real orientation according to the FH.
4. There may be any combination of the above-mentioned faulty orientations.

How is it possible, therefore, to use the frontal and lateral x-ray films, first, in relation to one another (first study) and, second, for superimposition of the different tracings of the same child over a period of years (serial growth study)? It is not necessary to revise the superimposition of the lateral tracings. The main research will be centered on the P-A film. The lateral film will be kept to check in which direction and how much the orientation of the P-A film diverges from the real FH plane.

Before elaborating on this problem, it is necessary to give a full description of the facial structures as seen in the P-A film. From the beginning the problem of reliable landmarks arises.

DETAIL DESCRIPTION

Three zones can be defined on the P-A film (Fig. 4):

A. Superior horizontal structure (*H*).
   1. The lateral and uppermost contour of the orbital ridge. Sometimes at this level, or above, the roof of the orbit may be seen. The roof of the orbit is sometimes confused with the supraorbital ridge.
   2. On the midsagittal plane, the ovoid contour of crista galli can be seen.
   3. Below the superior orbital line is the lesser wing of the sphenoid. It starts at the upper lateral and external corner of the orbital ridge, comes downward toward the midsagittal plane, and goes up again toward the opposite side.
   4. The oblique line (greater wing of sphenoid) goes from the upper lateral corner downward and inward.

B. Central structures (*C*).
   1. The neck of the perpendicular lamina of the ethmoid and the root of the nose can be traced. Nasion cannot be located with accuracy.
   2. The lateral walls of the nose present a thickness of 2 to 3 mm. due to the fact that the posterior and anterior parts of the nasal wall are superimposed on the film. It is not possible to distinguish accurately the anterior wall from the posterior one. As a rule, in this study the most lateral contour was taken into consideration.

3. The nasal septum, from the root to the floor of the nose, is fairly well defined.
4. At the level of the lower quarter of the nose, the occipital bone, the convex contour of the foramen magnum can be traced. The Bolton points bilaterally and basion at the uppermost convexity can be traced and offer, therefore, a checking point for the same points on the lateral film (Figs. 1 and 3).
5. Just below basion the odontoid process of the axis is clearly defined, as well as the articular surfaces with the atlas bilaterally (Fig. 3).
6. Below or superimposed with the odontoid process, the upper central incisors are always clear. The upper lateral incisors and canines offer more difficulty.
7. The four lower incisors are generally clearly defined.
8. The lower contour of the chin is always clear.

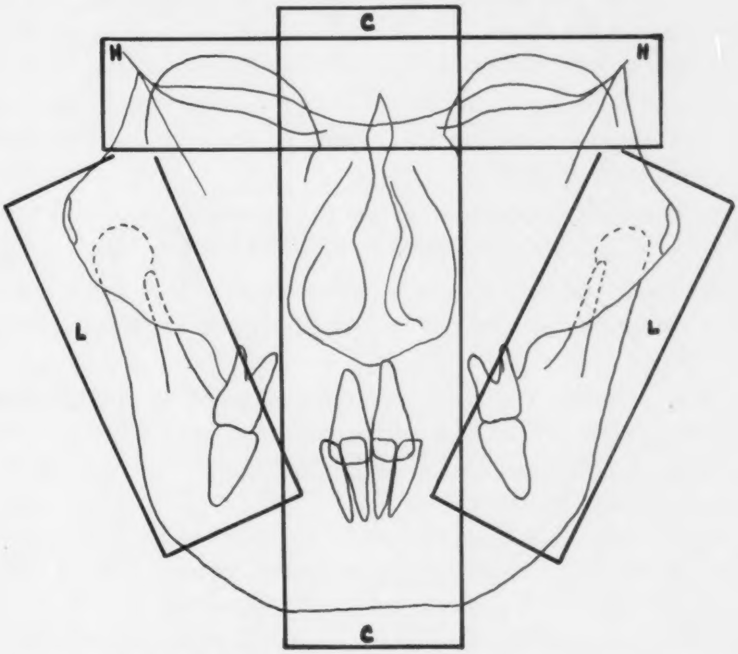


Fig. 4.—The three zones on the posteroanterior tracing. *H* = Horizontal, *C* = Central, *L* = Lateral.

C. Lateral structures (description for one side) (*L*).

1. The most lateral bony contours are: the parietal (above) and the mastoid (below).
2. Very seldom (at least in children) is the zygomatic arch lateral to the mastoid. The cross section of the zygomatic arch is often well seen. The earrods and the head of the mandibular condyle may be a guide in locating it. This landmark has been used by Broadbent.

3. Above the zygomatic arch, the external contour of the malar goes upward, toward the lateral orbital ridge, to the fronto-orbital suture. The most external point of this suture has been used by Harvold to establish a horizontal plane. The suture can be seen on the films of younger children (under 8 years of age) but on older children it is hardly discernible. In this study it has been traced where possible.
4. Below and medial to the zygomatic arch can be seen, with some difficulty, the roof of the glenoid fossa and the head of the mandibular condyle. More medially, the upper portion of the coronoid process goes downward and inward.
5. From the zygomatic arch to the upper molar, a continuous line goes downward medially, crosses the neck of the condyle and the body of the coronoid process, then bends downward to form the alveolar process. On the upper portion, this line is the lower contour of the malar, the maxillomalar suture, at the level of the coronoid process. On the lower portion, it is the maxilla with the key ridge (Atkinson).
6. The buccal contour of the crowns of the upper and lower molars is always clear, but their roots or their lingual contours are more difficult to trace.
7. The external contour of the ramus, the gonion, and the lower contour of the body of the mandible are always clear.

These are the structures that can be traced on a P-A x-ray film. The next problem that arises in the study of a P-A film is the correlative depth of each structure.

The P-A in Depth.—The study of depth may not be crucial when a face is investigated at a given time, but it becomes important when a serial study is done, that is, when tracings of successive P-A films of the same child are superimposed in order to assess growth.

There is no guarantee that the head has been oriented on exactly the FH plane at each visit of the child over a period of years. This is not due to the apparatus or the operator, but to the landmarks used and to the soft tissue around the external auditory meatus and around orbitale and nasion.

The answer to this problem is probably laminagraphy, which permits sections of the facial structures at different levels or depths. This technique is difficult to apply in current practice, and even in many research centers, because of financial and operating reasons. A close approximation can be obtained with the standard P-A film if the different structures in depth are considered separately.

For our purpose, the face was divided into three large zones, anteroposteriorly (Fig. 5). These zones are parallel to the P-A film:

1. *The anterior zone,* up to the first molars (*A*).
2. *The medial zone,* from the first molars to porion (M).
3. *The posterior zone,* posterior to porion (*P*).

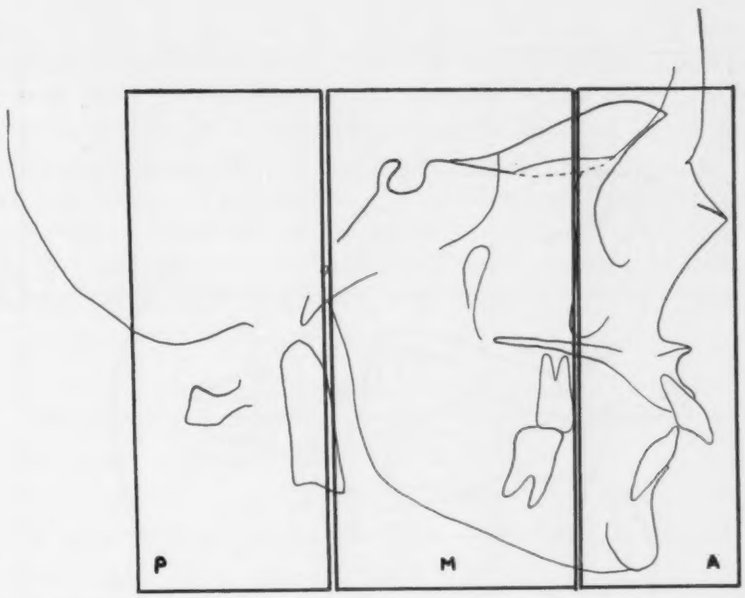


Fig. 5.—The three zones on the lateral tracing. A = Anterior, M = Medial, P = Posterior.

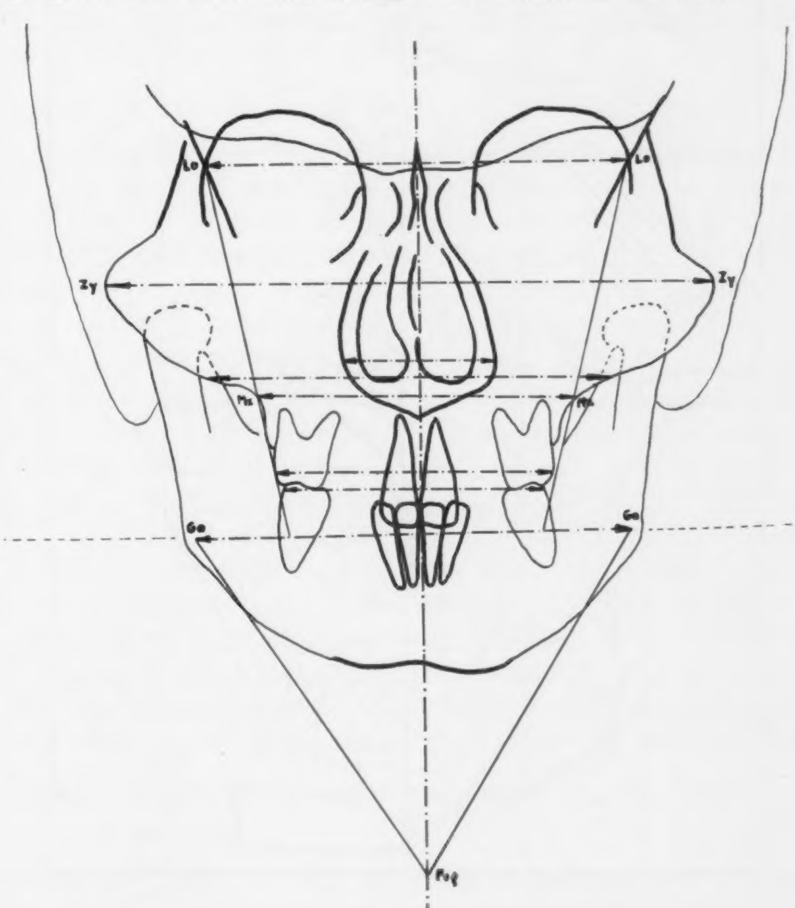


Fig. 6.—Construction of the vertical view of the mandible *Go-Pog-Go* and midline determination.

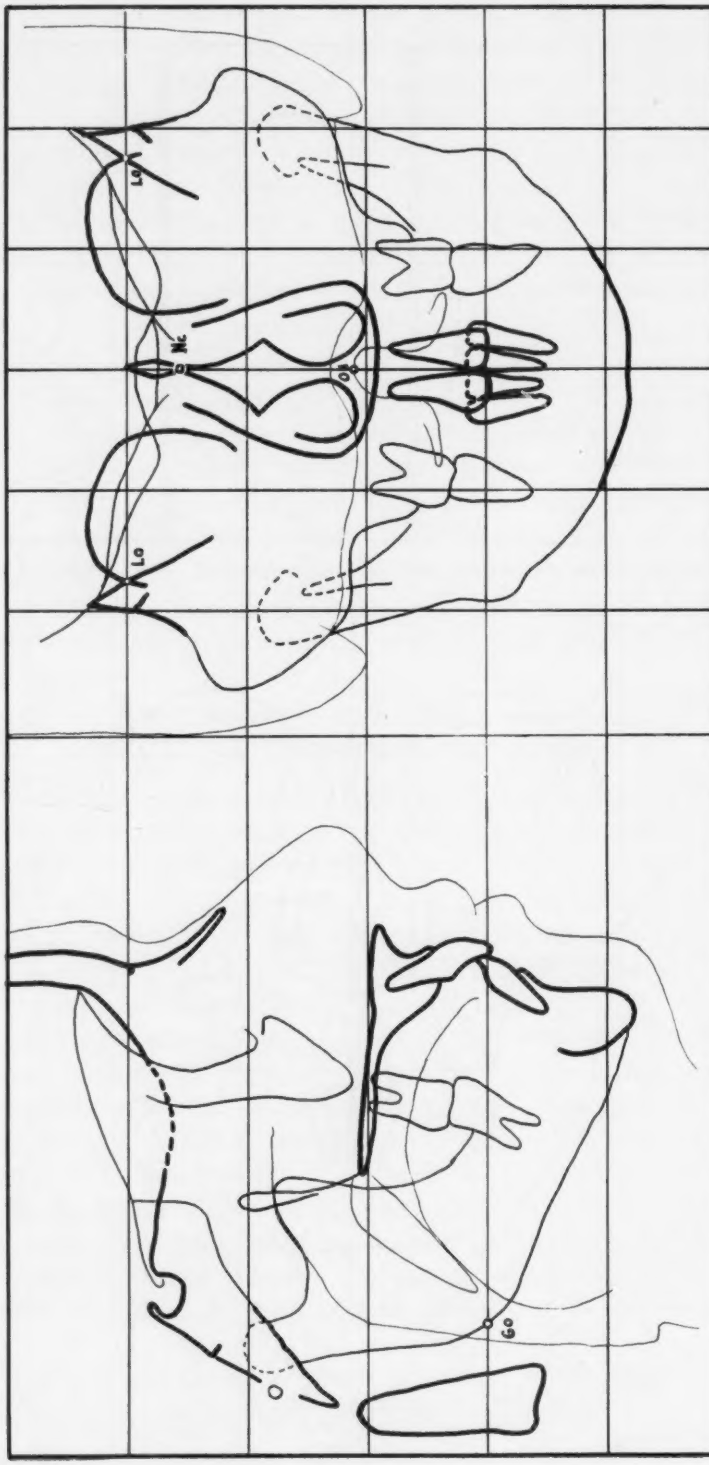


Fig. 7.—Reorientation of lateral and posteroanterior tracings on a millimeter grid.

For serial study, on the P-A film only the same zone can be compared on consecutive films of the same child. Therefore, a reference plane should be defined for each zone. As in the lateral x-ray films, the reference planes are preferably chosen within the cranial base which, in size and in position during growth, is relatively more stable than the rest of the face (Fig. 6). For the anterior zone the horizontal plane chosen is the bilatero-orbitale; for the medial zone, the uppermost contour of the lesser wing provides a good plane of reference; and for the posterior zone, the basion and the lower contour of the occipital bone are used, as well as the bimastoidale (Figs. 3 and 7).

Midline Determination (Fgs. 3 and 6).—

1. For the anterior and medial zones a common point, Nc, is used. Anteroposteriorly, this point extends to the posterior part of the nasal cavity and can be used for both zones.
2. For the posterior zone, basion is used as the midline. Odontoidale (Od) is a point common to both the lateral and the P-A films.

When, by this technique, the growth of each zone is assessed, their interrelation in the anteroposterior dimension can be calculated by referring to the lateral film. Therefore, the next step will be to correlate the P-A and lateral films of a given child taken at the same time.

REORIENTATION OF THE P-A AND LATERAL TRACINGS (FIG. 7)

*Millimeter Paper.—*It is a sine qua non condition that millimeter paper be used to correlate the P-A and lateral tracings. The millimeter paper should be large enough to accommodate the lateral and the P-A tracings on the same sheet. In this study the sheets of paper were 25 by 45 mm.

*First Step: Orientation of the P-A Tracing.—*The P-A tracing is horizontally oriented according to the bilatero-orbitale (Lo-Lo). This line is placed on a horizontal line on the millimeter paper; then the point Nc on the tracing is placed on a vertical millimeter line. The axis of the earrods may not lie on the same horizontal line. This difference will show the amount of tilting of the head and/or the asymmetry of the face.

Second Step: Positioning of the Lateral Tracing.—(1) The lowermost border of the chin is put on the same horizontal plane (check the level of the incisal edge of $\underline{1|}$) and (2) the center of the mechanical porion of the lateral tracing is put on the same level as the horizontal midline of the centers of the earrods of the P-A tracing (check the level of basion, the level of odontoidale, and, where possible, the level of the heads of the condyles).

This correlation between the P-A and lateral tracing presupposes that the child's head has not moved between the taking of the lateral and the P-A films.

CORRELATION OF THE P-A AND LATERAL FILMS WITH THE MODELS

Two solutions are possible:

1. *Orientation of the Dentition According to Lateral and P-A Films (Fig. 8).—*(a) Trim the base of the mandibular model according to the mandibular

base plane; (b) trim the base of the maxillary model according to the palatal plane; (c) trim the lateral sides of the models parallel to the midsagittal plane; and (d) trim the posterior portion of the models perpendicular to the Frankfort horizontal. In this way, the models are oriented according to their basal structures (palatal and mandibular planes) and also according to their plane of orientation (FH).

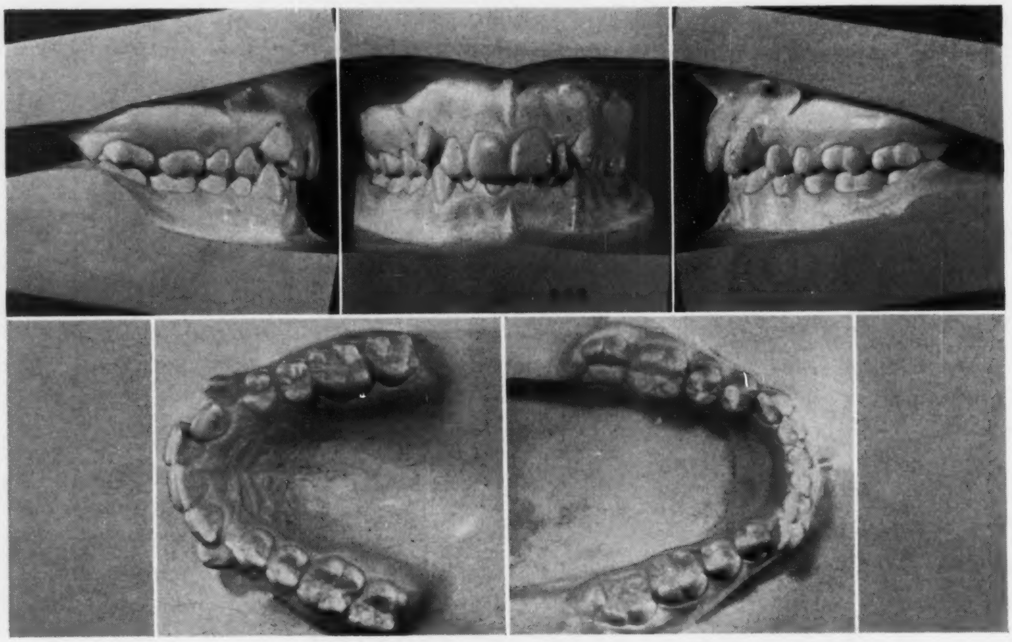


Fig. 8.—Dental models trimmed according to their structural base: the palatal plane for the maxilla, the mandibular base plane for the mandible. The lateral sides are parallel to the midsagittal plane, the posterior side is perpendicular to the FH.

2. *Integration of the Teeth in the Lateral and P-A Films.*—The photographing of the models should be taken with a sheet of millimeter paper as a background.

(a) *Integration on the lateral film:* The pictures should be taken perpendicular to the midsagittal plane, then enlarged according to the midsagittal scale.

If the scale is not used, measure the distance between $\underline{6}$ and $\underline{1}$ on the model and on the film and enlarge the picture according to the dimensions of the film. Then the picture of the crowns can be pasted on the tracing paper.

(b) *Integration on the P-A film:* The picture should be taken with the models oriented according to the FH; then the buccal diameter of the upper molars should be measured on the P-A tracing and the picture enlarged accordingly.

(c) From the combination of the lateral and P-A tracings, the real vertical view of the mandible can be drawn. The picture of the lower dentition must be taken perpendicular to the occlusal plane.

The lower molar buccal diameter is measured on the P-A tracing and the picture is enlarged accordingly.

To position the photograph of the mandibular teeth on the mandible, the horizontal distance between the tip of 1 to Pog. is measured and the photograph can be placed accordingly.

CHAPTER ONE. PLACE OF THE UPPER PERMANENT MOLAR ANTEROPOSTERIORLY

A. *Method.*—On the lateral tracing, the four planes and anterior and posterior arcs are constructed. From the same focal point O, and with O-Te as radius, the arc is drawn downward. This arc will be referred to as "the temporal arc."

B. *Measurements (Fig. 9).*—(1) the distance from the mesial contour of 6 to the temporal arc (– if 6 was posterior to the arc, + if anterior); (2) the distance from ANS to the anterior arc passing trough nasion; and (3) the distance from 1 to the anterior arc.

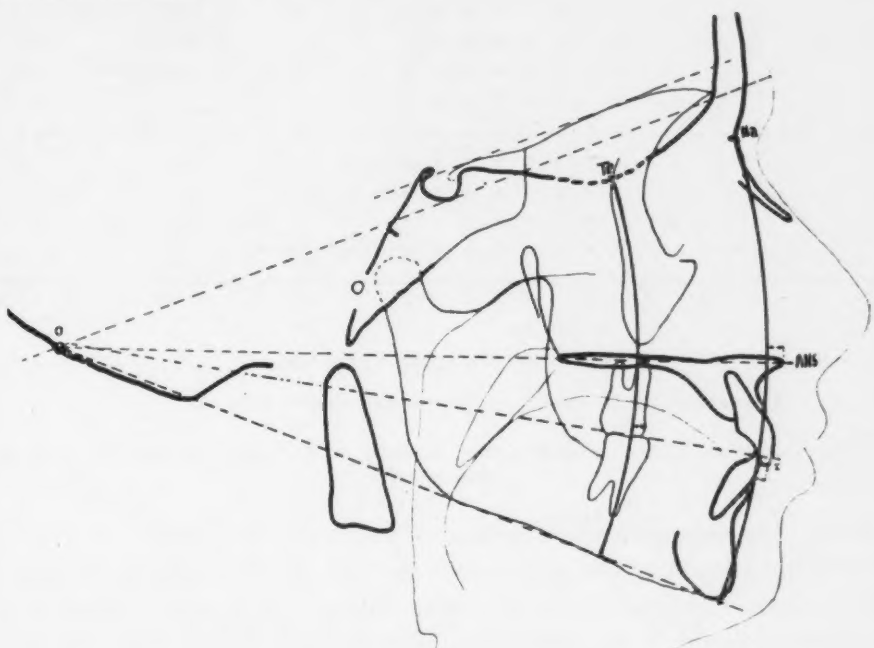


Fig. 9.—Construction of the temporal arch (*Te* arc). From *O* as center and *O-Te* as radius, the arc is drawn downward. The distance from this arc to the mesial contact point of 6 is measured along a radius.

(All dimensions posterior to a given arc are noted –; those anterior to the arc are designated +.)

C. *Findings.*—(1) The *distance* Te-Na (measured on a radius) is equal to ANS-6 (Fig. 10); (2) the *position* of 6 is anterior or posterior to the temporal arc and is the same distance as ANS anterior or posterior to the anterior arc (in other words, the 6 bears the same relationship to the temporal arc as ANS to the anterior arc); and (3) the position of 6 varies with the position of 1.

D. *Discussion.*—The anteroposterior position of 6, according to Fig. 10, shows some variations. Between the normal groups and the different groups of malocclusion there is no set difference in the position of 6. This is true if we consider that all Class II, Division 1 malocclusions, for example, are alike. But if we break the Class II, Division 1 into two major groups, according to the position of 6, we will have to deal with two opposite groups of Class II, Division 1. A tendency for 6 to be more posteriorly situated among adults and members of the Class III group and more anteriorly situated in the Negro group may be noted.

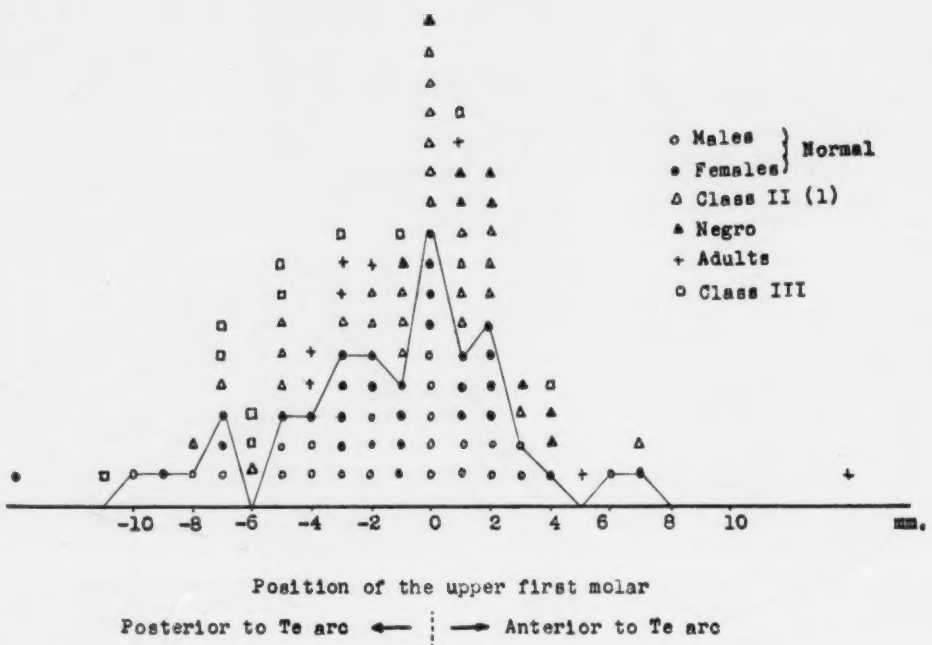


Fig. 10.—Distribution of the anteroposterior position of 6, relative to the *Te*- arc, for the total sample.

What may influence the position of 6 anteroposteriorly? The following factors will be examined in sequence: the size of the teeth (static), position of the incisors (dynamic), the muscular balance (dynamic), influence of the position of the palate in the craniofacial complex, and genetic influence.

The size of the teeth: The basic hypothesis is that, if 6 has a fixed position in the face, any increase in the total upper dental arch length will be transferred to the incisor area. In other words, the greater the arch length, the more protrusive the upper incisors. This study failed to demonstrate this. A large amount of tooth structure may influence the position of the dental arch, either anteriorly or posteriorly.

Position of the upper incisors: Here the central tendency is that, comparative to the facial structures, 6 and 1 tend to vary anteroposteriorly. The more anterior 1 is, the more anterior 6 is. Therefore, an accurate definition of the

position of $\underline{1}$ will clarify the position of $\underline{6}$ also. In a previous investigation,[28] it was found that $\underline{1}$ is situated on the anterior arc. This is the central tendency, but $\underline{1}$ may be influenced as to its position and axial inclination by its opposing mandibular teeth. Therefore, their interinfluence was tested.

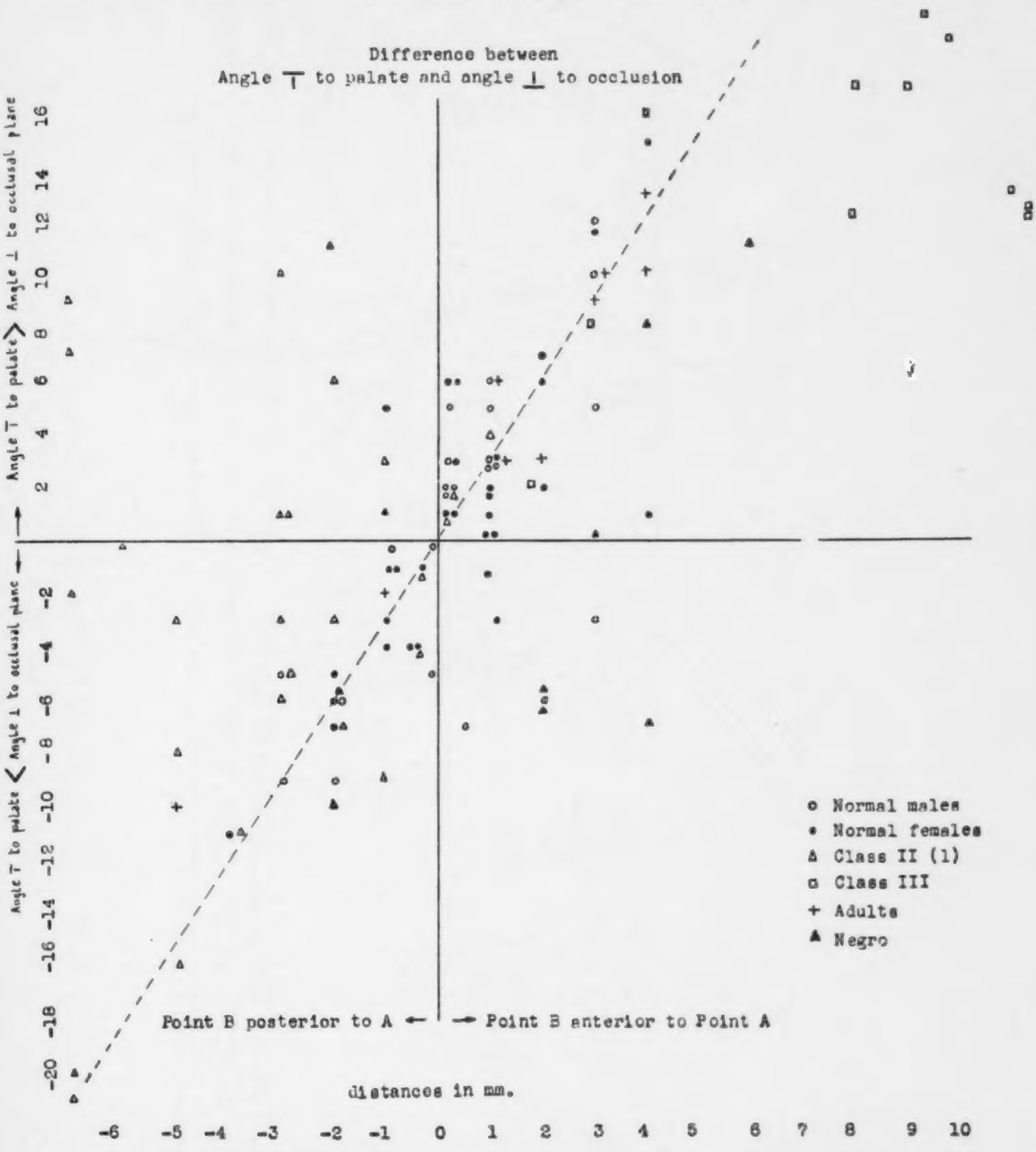


Fig. 11.—Correlation diagram between the anteroposterior position of the mandible and the axial inclination of the upper and lower central incisors.

Method (Fig. 12, a).—From O as center and OA as radius, an arc (the basal arc) is drawn downward. The distance of point B to this arc is measured. A plus (+) sign is used when B is anterior and a minus (–) sign is used when B is posterior to the arc. It was stated previously[28] that $\underline{1}$ forms, with the occlusal plane, an angle equal to the angle formed by $\overline{1}$ and the palatal plane (Fig. 13, a). The

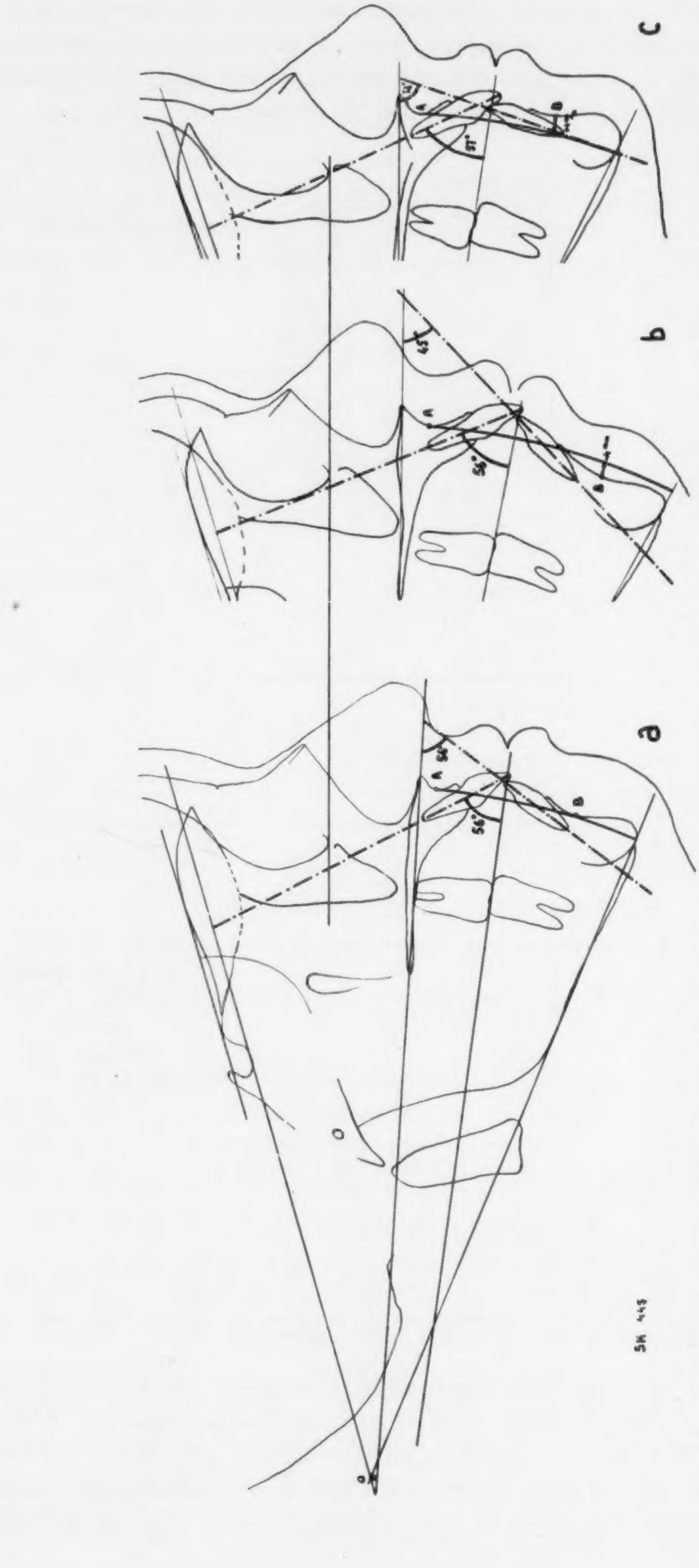


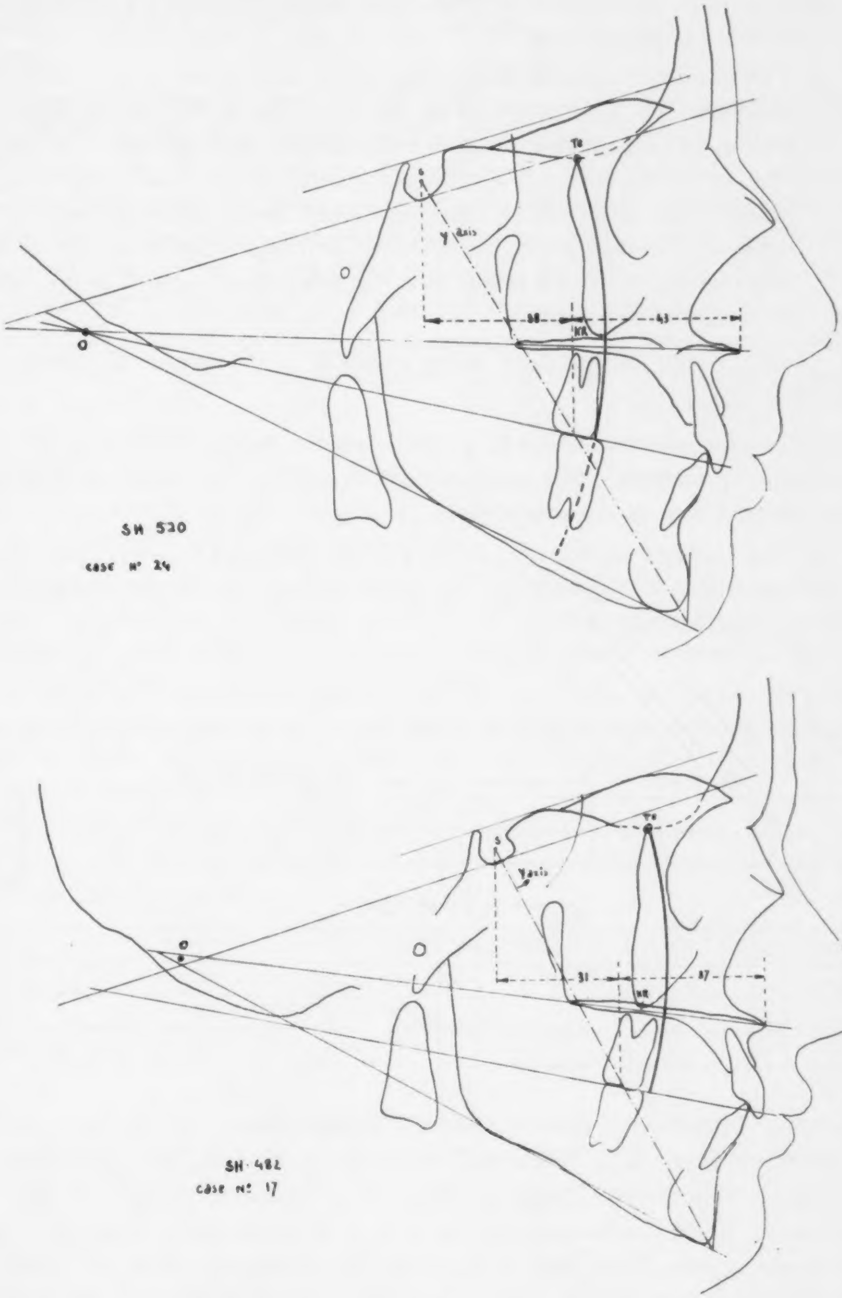
Fig. 12.—*a*, When point *A* and point *B* are on the same arc (center *O*), the angle formed by the upper incisor and the occlusal plane is equal to the angle formed by the lower incisor and the palatal plane.

b, When point *B* is posterior to the arc passing through *A*, the angle formed by the lower incisor and the palatal plane is smaller than the angle formed by the upper incisor and the occlusal plane.

c, When point *B* is anterior to the arc passing through *A*, the angle formed by the lower incisor and the palatal plane is larger than the angle formed by the upper incisor and the occlusal plane.

difference between these two angles was assessed. The sign + is used when the $\overline{1}$ angle is larger than the $\underline{1}$ angle, and – is used when the $\overline{1}$ angle is smaller than the $\underline{1}$ angle.

a.



b.

Fig. 13.—*a*, Position of $\underline{6}$ according to four different analyses. Case No. 24: The evaluations are in agreement.

b, Position of $\underline{6}$ according to four different analyses. Case No. 17: The evaluations are in disagreement.

Findings. Fig. 11 shows that:

1. When point B is situated on the arc passing through A, angle $\bar{1}$ to the palatal plane is equal to the angle formed by the axis of $\underline{1}$ with the occlusal plane (Fig. 13, *a*).
2. The more the point B is posterior, the smaller the $\bar{1}$ angle compared to the $\underline{1}$ angle (Fig. 12, *b*).
3. The more the point B is anterior to the arc A, the larger the $\bar{1}$ angle compared to the $\underline{1}$ angle (Fig. 12, *c*). This is, indeed, an important finding, for it gives a relative value to the position and axial inclination of the incisors. It also shows the influence of the anteroposterior mandibular position on the maxillary teeth. Calculated on this diagram, the following relationship is found: for every 2 mm. of B anterior to A arc, $\bar{1}$ angle is 3 degrees larger than $\underline{1}$ angle, with a deviation of ± 1 degree.

The Class II and III groups were assessed on the same diagram. The findings are:

1. The majority of Class II cases lie above the dotted line, in the lower left quadrant. The majority of the Class III cases lie below the dotted line, in the upper right quadrant.
2. The incisors in the majority of Class II and Class III cases do not seem to be subjected to the same interaction as the subjects with normal occlusion.

Table I

mm		-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	mm
					B post. to A ←										→ B ant. to A											
N ♂	4								1	3	1	7	6	1	4											11
N ♀	9							1		2	6	5	9	3		2										14
Total	13							normal range of variation				12														25
cl II (1)	26			1	5	1	3	2	7	3	4	2	1													1
Negro	3									2	1			2	1	2		1								6
Adult	2						1				1		2	1	2	2										7
cl III														1	1	1				2	2	1	1	2		11

A possible explanation may be that the interaction of the incisors can take place only when there is a functional relationship between the maxillary and mandibular anterior teeth. When this fails, as in Class II, Division 1 and Class III, there is no more intercompensation and their divergence from the normal trend is accentuated. Then the upper and lower incisors seem to behave independently and fall under the influence of lip, tongue, finger, and other habits, which emphasize the initial discrepancy even more.

Table I shows that in the majority of the Class II, Division 1 cases (twenty-six) point B is posterior to point A and that in the Class III cases point B is

anterior to point A. The tendency in the adult and Negro groups is also for point B to be anterior to point A.

For a more accurate evaluation of the preceding interinfluence, longitudinal study should be done with this method.

It has been seen that part of the answer regarding the variation of the $\underline{6}$ position anteroposteriorly lies in the correlative position and influence of the mandible.

Muscular balance: By musclar balance, anteroposteriorly speaking, we understand mainly the balance between the tongue and the lips. It was not possible in this study to assess this balance. The following, therefore, is a theoretical discussion in preparation of a further study. If we believe that the tongue-lip balance may have an influence on the anterior teeth (as often observed clinically), then it may bring some light into the assessment of the variation of the position of $\underline{6}$. Clinically, it is observed that tight lip muscles tend to keep the incisors posterior. Eventually, if enough room is not found posteriorly, crowding will occur. It has been demonstrated previously that $\underline{6}$ and $\underline{1}$ tend to vary together anteroposteriorly; therefore, if the tight lip musculature keeps $\underline{1}$ posterior it also tends to keep $\underline{6}$ posterior. When this does not happen crowding, or impaction, may occur. This last statement, however, needs to be substantiated by an appropriate study concerning the strength of the lips in function and at rest, coupled with a longitudinal study.

Structural influence of the palate: The position of the palate, besides being defined according to the three other facial planes (mandibular, occlusal, and supraorbital), has been correlated particularly with the occipital bone.

Method.—Three points are defined on the foramen magnum: basion anteriorly, opisthion posteriorly, and the Bolton points bilaterally. A fourth point, although less stable, was used. It is the odontoidale, uppermost point of the odontoid process of the axis.

The palatal plane (ANS-PNS) is prolonged posteriorly. The position of this plane was assessed relative to the four points defined above. The following nomenclature was used:

M = When the palatal plane passes within the zone defined by the four points (occipital quadrilateral zone).
A = When it passes above.
B = When it passes below.

TABLE II

	B	M	A	TOTAL
Normal ♂ + ♀	14	23	15	52
Class II, Division 1	18	7	2	27
Class III	—	9	2	11
Negro	6	3	—	9
Adults	3	3	3	9
Total	41	45	22	108

Findings.—Table II gives the distribution of the position of the palatal plane for the present sample. In this table can be seen the regular distribution in the normal series. In the Class II, Division 1 group the majority of the cases

have a palatal plane passing below the occipital zone. In the Class III group no case has a palatal plane passing below the occipital quadrilateral zone. In the Negro series no case passes above the occipital quadrilateral zone.

The next step was to couple this finding with the anterior upper and lower facial heights. (The anterior upper face, UF, is measured on the anterior arc between the supraorbital plane and the palatal plane. The anterior lower face, LF, is measured on the anterior arc, between the palatal plane and the mandibular plane). Table III shows the distribution for the total sample. This table shows (percentagewise) that when the palatal plane passes below the occipital zone, the lower anterior face is larger than the upper anterior face. When the palatal plane passes above, in the majority of the cases, the lower anterior face is smaller than the upper anterior face. This suggests that the disproportion between upper and lower anterior face is due primarily to the position of ANS; in a lesser degree, it is due to the position of PNS and gnathion.

TABLE III

	LF < UF	LF = UF	LF > UF	TOTAL
B	6	2	33	41
M	21	6	18	45
A	14	2	6	22
Total	41	10	57	108

The next step was to try to correlate the position of $\underline{6}$ and the position of the palatal plane; this failed to show any correlation. To give a definitive answer, multicorrelations are necessary, because two or more variables together may bring into evidence what they do not show individually.

Genetic influence: This requires a special study. Maybe some of the variations of the position of $\underline{6}$ should be attributed to the genetic background of the subject. If this is true, then it should be admitted that $\underline{6}$ position is stable not only from one person to the other, but also throughout life. Only a longitudinal study coupled with the study of the parents can show such an assertion.

Conclusion on the Anteroposterior Position of $\underline{6}$.—As we have seen, the upper first molar has, in the craniofacial complex, a position which is only relatively fixed. Its variation on both sides of the central tendency is important. The position of $\underline{6}$ is too dependent on the general balance of dento-skeleto-muscular interaction to be used without many reservations as a basis in the classification of malocclusion.

As a test, four different methods have been applied to the same cases, to compare the answers. The sample used is the entire group of female subjects with normal occlusion (twenty-nine cases).

The various methods used are as follows:

Atkinson and Zsigmondy. Correlating the key ridge with the upper first permanent molar (mesiobuccal root).

Brodie. The Y axis (S-Gn) should pass through $\underline{6}$ (buccal groove).

Wylie. The use of horizontal proportions to assess anteroposterior dysplasia.

The results of these three methods and those from the present study have been gathered in Table IV to present analogies and differences of opinion.

Nomenclature:

A = $\underline{6}$ is anteriorly situated.
P = $\underline{6}$ is posteriorly situated.
O = $\underline{6}$ is well positioned according to each analyst's definition.

Table IV shows that there is unanimity in five cases and that three out of four came to the same conclusion in nine cases. Fig. 13, *a* and *b* shows two cases. In the first one (Fig. 13, *a*), the four analyses give the same answer. The second one (Fig. 13, *b*) gives different answers.

These divergences show that, even with quantitative evaluation, the answers to any problem should be interpreted with care.

TABLE IV

CASES	ATKINSON	BRODIE	WYLIE	PRESENT STUDY
1	O	A	P	P
2	P	P	P	P
3	A	A	A	O
4	O	A	A	O
5	A	O	A	O
6	A	O	A	A
7	O	O	P	O
8	O	P	P	A
9	A	A	A	A
10	A	O	O	P
11	A	A	P	P
12	A	A	P	P
13	O	A	O	O
14	P	P	P	P
15	A	A	O	O
16	A	A	A	A
17	A	O	P	P
18	O	P	P	O
19	A	A	A	O
20	A	O	O	P
21	O	P	A	O
22	O	A	O	A
23	O	P	O	P
24	O	O	O	O
25	A	O	A	A
26	O	A	O	O
27	O	O	A	O
28	P	O	P	P
29	A	O	P	P

CHAPTER TWO. POSITION OF $\underline{6}$ TRANSVERSELY

Although many studies have been done on the lateral x-ray film, very few are available concerning the frontal view. Those found in the literature are concentrated mainly on the definition of the midsagittal plane to assess either the midline of the upper and lower teeth or the asymmetry of the face. The purpose of the present chapter is to define the position of $\underline{6}$ according to the facial structures as seen on the P-A film.

Method (Fig. 14).—A line connecting Lo (latero-orbitale) and Mx (maxillare) is drawn and prolonged downward. Line Lo-Mx in its upper half-section,

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The results of these three methods and those from the present study have been gathered in Table IV to present analogies and differences of opinion.

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A = 6 is anteriorly situated.
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1	O	A	P	P
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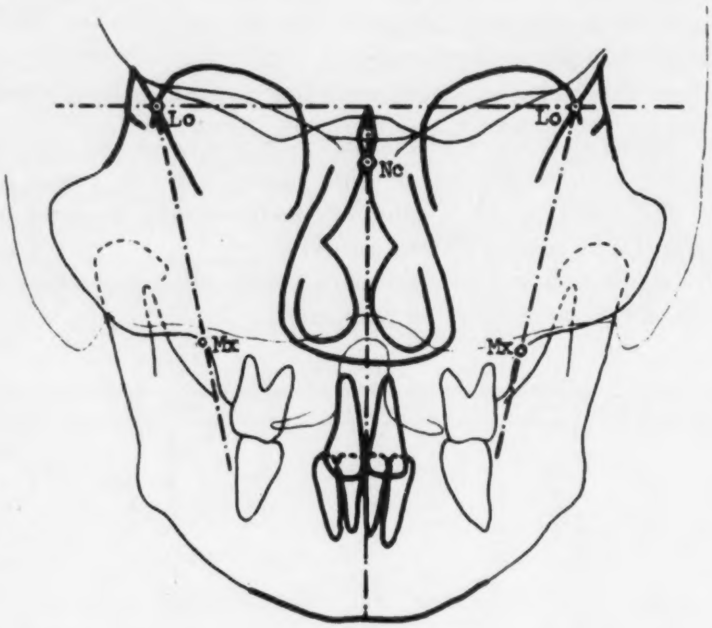
5	A	O	A	O
6	A	O	A	A
7	O	O	P	O
8	O	P	P	A
9	A	A	A	A
10	A	O	O	P
11	A	A	P	P
12	A	A	P	P
13	O	A	O	O
14	P	P	P	P
15	A	A	O	O
16	A	A	A	A
17	A	O	P	P
18	O	P	P	O
19	A	A	A	O
20	A	O	O	P
21	O	P	A	O
22	O	A	O	A
23	O	P	O	P
24	O	O	O	O
25	A	O	A	A
26	O	A	O	O
27	O	O	A	O
28	P	O	P	P
29	A	O	P	P

CHAPTER TWO. POSITION OF 6 TRANSVERSELY

Although many studies have been done on the lateral x-ray film, very few are available concerning the frontal view. Those found in the literature are concentrated mainly on the definition of the midsagittal plane to assess either the midline of the upper and lower teeth or the asymmetry of the face. The purpose of the present chapter is to define the position of 6 according to the facial structures as seen on the P-A film.

Method (Fig. 14).—A line connecting Lo (latero-orbitale) and Mx (maxillare) is drawn and prolonged downward. Line Lo-Mx in its upper half-section,

represents approximately the direction of the anterior fibers of the temporalis muscle. Its path is close to the maxillo-zygomatico-temporal sulcus (MZT) as seen in the lateral film.



— Anterior structures
— Medial structures
— Posterior structures

Fig. 14.—Assessment of the transverse position of 6|6. The distance between the buccal contour of 6 to the line *Lo-Mx* indicates a constricted or expanded bimolar diameter.

Measurements.—The distance from the buccal contour of 6 to line Lo-Mx was measured. When line Lo-Mx crosses 6, a plus sign is used. When 6 is inside, toward the midsagittal plane, the distance to Lo-Mx is designated by a minus sign. When Lo-Mx is tangent to the buccal contour of 6 it is indicated as zero.

TABLE V

LEFT

	6 lingual	-5	-4	-3	-2	-1	0	1	2	3	4	5	6 buccal (m/m)
Normal ♂	6				1	5	12	2	2	1			5
Normal ♀	12					12	9	4	3		1		8
total	18						21						13
cl. II (1)	17		1	2	5	9	7	3	1				4
Negro	3				1	2	2	2	1		1		4
Adult	3			1		2	3	2					2
cl III	1				1		2	3	2	1	1		7

RIGHT

	6 lingual	-5	-4	-3	-2	-1	0	1	2	3	4	6	6 buccal
Normal ♂	11			2	4	5	8	3	1				4
Normal ♀	12			1	4	7	6	7	4				11
total	23						14						15
cl. II (1)	19		2	6	6	5	7	1	1				2
Negro	6				3	3	2				1		1
Adult	5			2	2	1	2	1					1
cl III	3			1	1	1	2	1	2		2		5

Findings.—Table V shows the distribution for the total sample. One is for the left molar, the other is for the right one. From this table we see that: (1) the variation of 6 laterally is slight (± 1 to 2 mm.), seen mostly in the sample with normal occlusion; (2) there is some difference between left and right sides, which shows the amount of asymmetry either of 6 or of the facial structure (line Lo-Mx); (3) the Class II, Division 1 group shows a tendency to be (percentagewise) on the minus side, that is, to have a bimolar diameter smaller than the sample with normal occlusion; and (4) the Class III group shows a tendency to have a bimolar diameter larger than the sample with normal occlusion (since this is less clear it may be due to the small sample).

We are less interested in the groups than in each individual case. Here again, we see that a Class II, Division 1 case can have a relatively wide arch, as well as a narrow arch. We have seen that in Class II, Division 1, 6 can be anterior or posterior. The recognition of these positions is important for treatment purposes in making it possible to make a *differential diagnosis* and, therefore, a *differential treatment.*

6 | 6 Diameter in the Dental Arch (Fig. 15).—Next we will assess the interrelation of 6 in the transversal dimension with 3 | 3 position. This assessment was done directly on the dental models. Two dimensions were taken—the bimolar diameter measured from the mesiobuccal cusp and the bicanine diameter at the tip of the cusp.

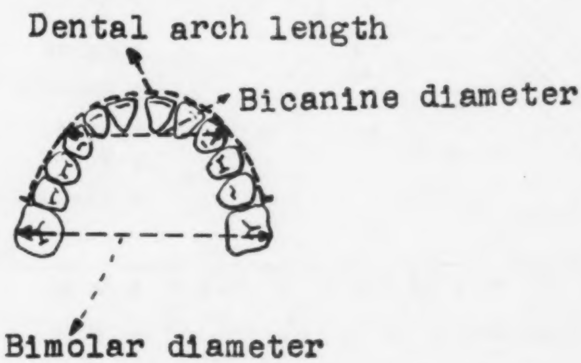


Fig. 15.—Measurements taken on the model.

Fig. 16 shows that:

1. With few exceptions, the bimolar diameter and the bicanine diameter are correlated.
2. The central tendency for the bicanine diameter is to be three-fifths of the bimolar diameter (± 2 mm.).
3. This proportion holds for all groups.
4. In absolute measurement, this figure shows a concentration of Class II, Division 1 in the lower range (narrow arch) and a concentration of Negro values in the upper range (wide arch). This confirms the

previous statement that the bimolar diameter in Class II, Division 1 is relatively smaller. Now we see that this is true in absolute measurement also. We see, too, that the same constriction is found at the bicanine level.

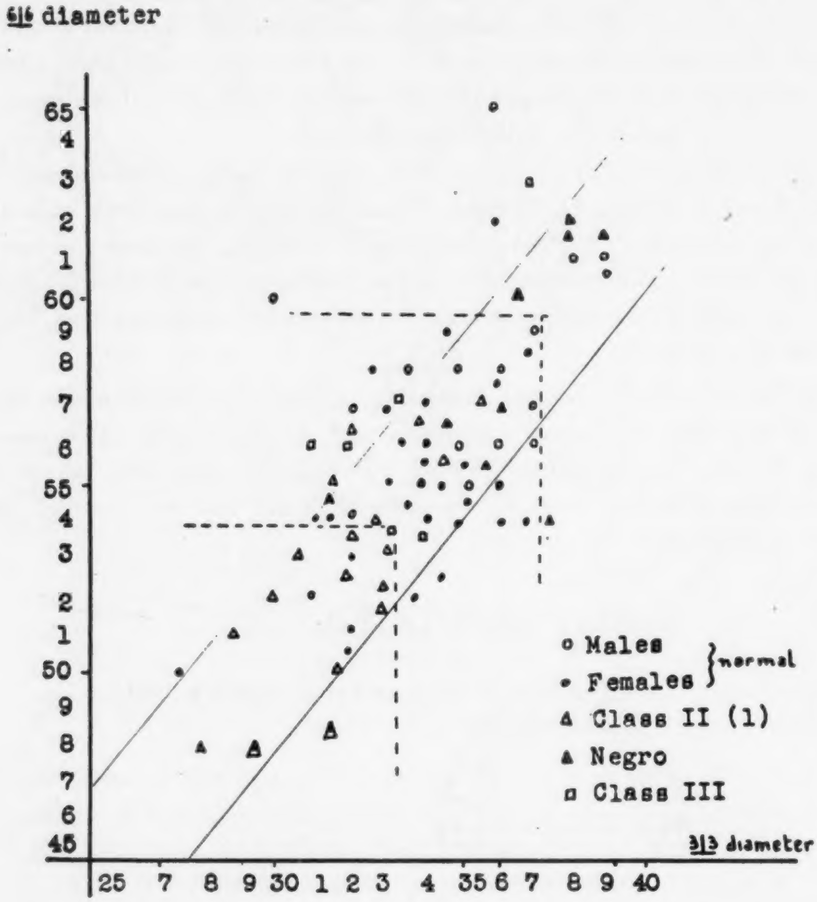


Fig. 16.—Correlation between 6|6 transverse diameter and 3|3 transverse diameter.

Influence of the Mandible (Fig. 17).—The next step will be to see what influence the mandibular molars may have on the transverse position of 6 | 6 through function. The bigonial diameter was measured and the correlation assessed with the mandibular bimolar diameter. Fig. 17 shows a moderate correlation.

Compared to the central tendency (median line):

1. The majority of the Class II, Division 1 cases lie below the central line; this means that, relative to the bigonial diameter, the mandibular bimolar diameter is small.

2. The Class III and Negro cases lie above the central line; this means that, relative to the bigonial diameter, the mandibular bimolar diameter is large.
3. All groups (Class II, Class III, and Negro) are approximately within the same range of variation as the group with normal occlusion.
4. There are Class II, Division 1 cases which have a large bimolar diameter. Expansion is contraindicated in those cases.
5. There are Class III cases which have a narrow bimolar diameter. Expansion may be indicated in those cases.

Discussion.—The previous statements suggest the hypothesis that the bimolar diameter, and therefore the position of $\underline{6}$ in the transverse dimension, is the end result of the interaction between the maxilla and the mandible, the teeth being the medium.

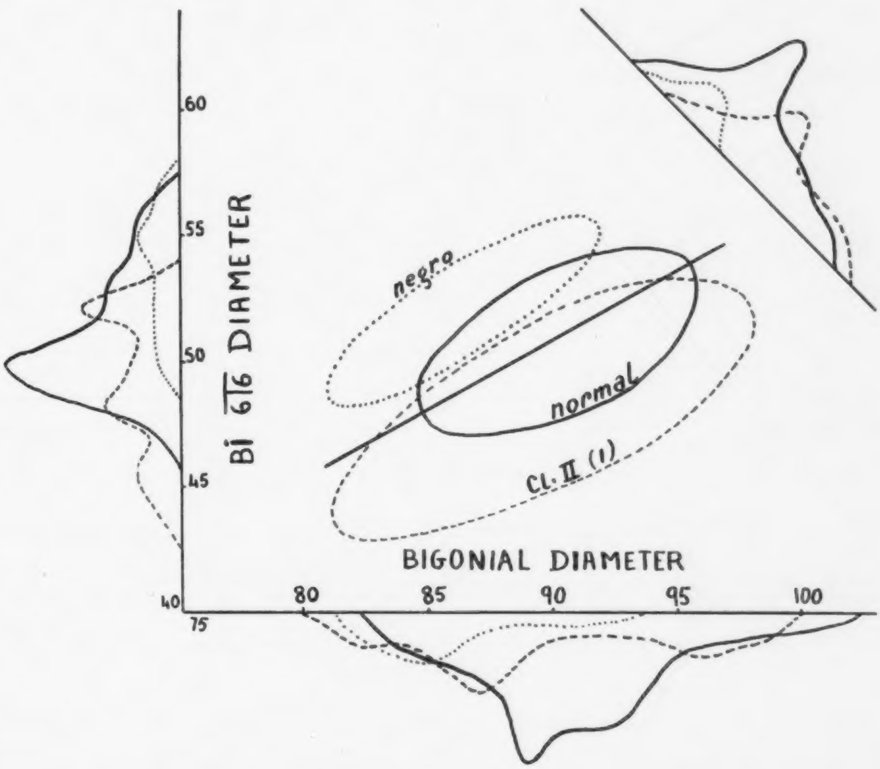
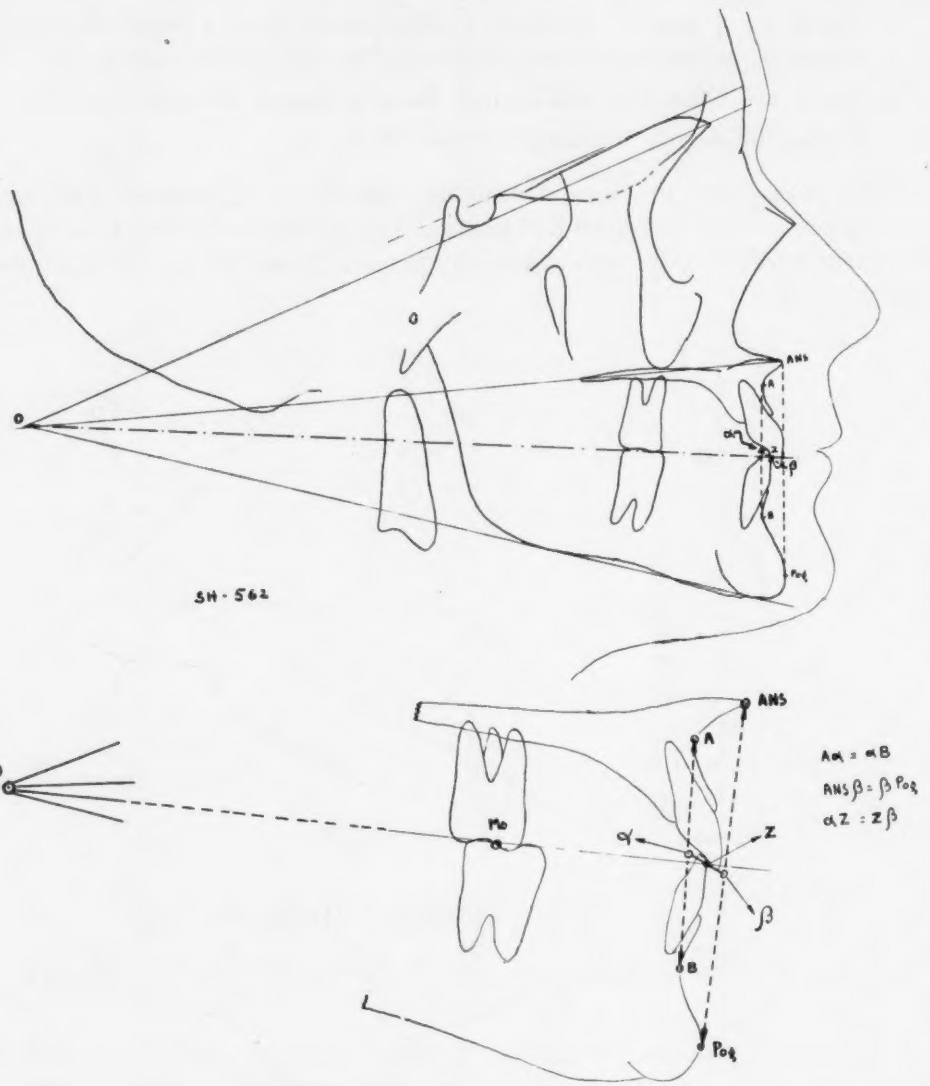


Fig. 17.—Correlation between the bigonial diameter and the mandibular bimolar diameter.

Again we have to mention the importance of the muscle balance (cheek-tongue) and the inclined plane relationship of the cusps, although this influence is less than in the incisor area. A proof of this assertion is the very low range of variation of $\underline{6}$ compared to line Lo-Mx, unless we assume that maxillare (Mx) is also under the influence of the same muscles. This requires a complete study

in itself and requires instruments which we do not possess (electromyograph). This also requires experimental research which is possible only on animals since it involves removal of the buccinator and the tongue.

a.



b.

Fig. 18, *a* and *b*.—Construction of point Z. α = Midpoint of the distance *A-B* along *A-B* line. β = Midpoint of the distance *ANS-Pog* along *ANS-Pog* line. *z* = Midpoint of the distance α–β along α–β line.

CHAPTER THREE. POSITION OF THE $\underline{6}$ VERTICALLY

This part of the problem has been dealt with in a previous study. It was found that the occlusal plane, when prolonged posteriorly, passes through point O.

This plane is dependent on three points: the focal point O; the point Mo, which is the intersection of the cusps of the upper and lower molars; and the point Z, which is the intersection of the overbite of the central incisors.

We can locate, by construction, the focal point O. Therefore, if we locate point Z, we will have the vertical position of M by drawing the plane O-Z.

Method (Fig. 18, a and b).—(1) The distance between A and B was measured and the midpoint was taken; this point was called α. (2) The distance between ANS and pogonion was measured and the midpoint was taken; this point was called β.

Findings.—(1) Point α is at the same level as the occlusal border of the lower central incisor. (2) Point β is at the same level as the occlusal border of the upper central incisor. (3) Point Z, the one we were looking for, is at the midpoint between α and β.

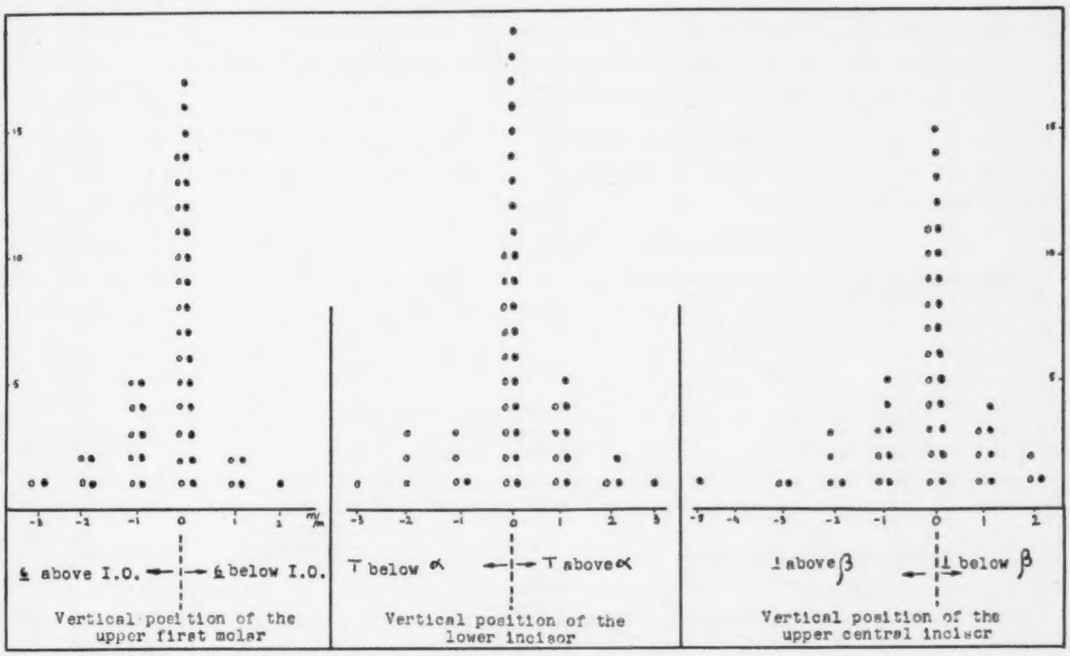


Fig. 19.—Distribution of the vertical assessment of the position of 6, 1, and 1 for the cases with normal occlusion.

Discussion.—From points Z and O, it is possible to trace the occlusal plane and assess the vertical position of 6. Fig. 19 shows the very small variation of 6 vertically. This means that 6 is stable, vertically speaking, not in an absolute way, but in a relative way. It is subjected to the variation in height of the bony bases of the teeth (the palate and the mandible) and to the height of the alveolar bone and the teeth (distance AB).

The slight amount of variation of 6 vertically may be explained partly by the correlative variation of the posterior zone of the palate and the mandible. There is a definite correlation between the position of 6 and the vertical position

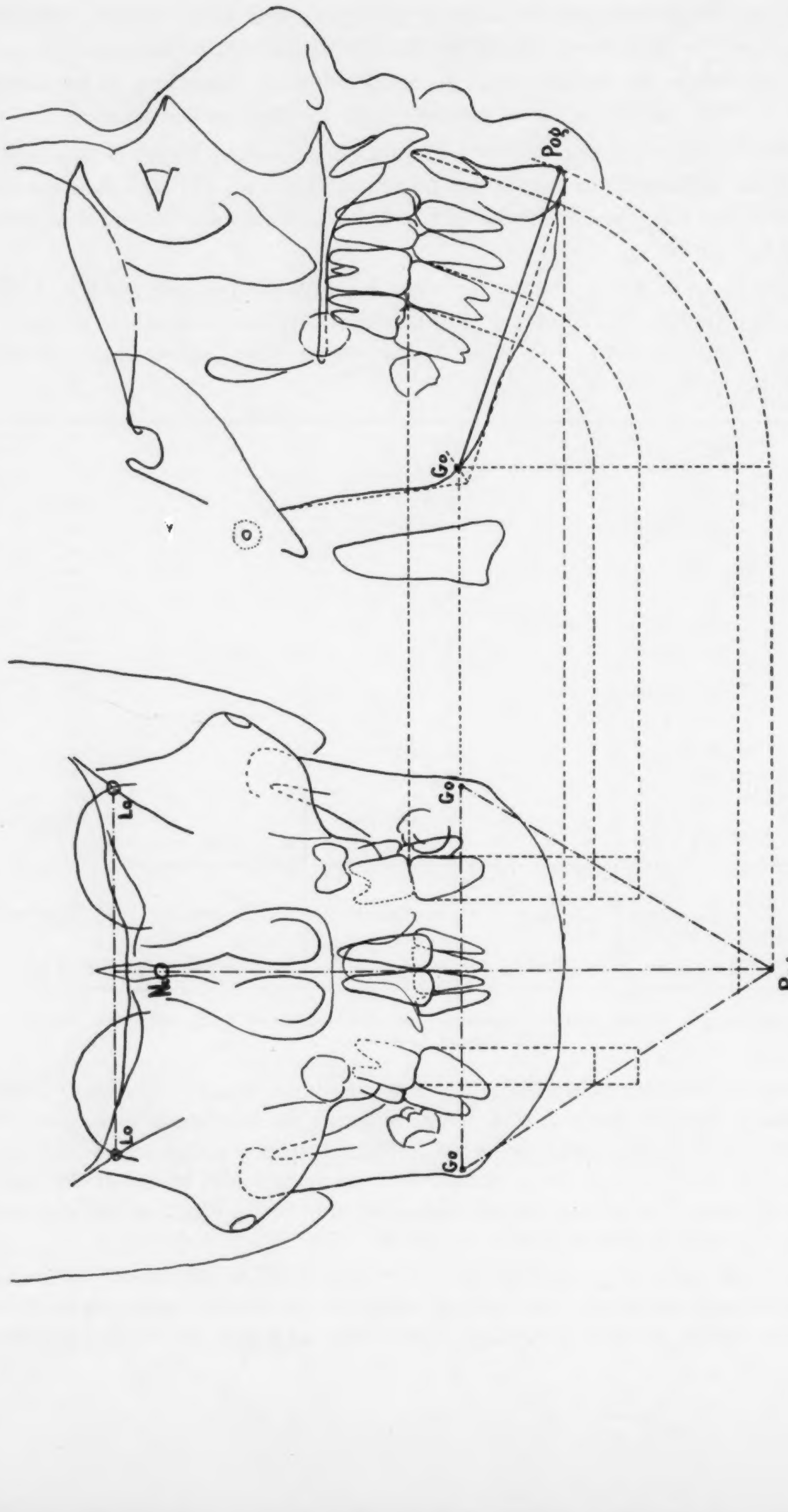


Fig. 20.—Reconstruction of the mandible. *Go-Pog* on the vertical view represents the real size of the corpus. Notice that the mandible as seen from above forms a nearly perfect equilateral triangle *Go-Pog-Go*. In other words, the bigonial diameter is equal to the real length of the corpus. (For the models of this case, see Fig. 8.)

of the palate and the mandible. These two basal structures tend to carry the teeth. This is, however, only part of the problem. The functional resistance of the basal bone is probably another factor in the extruded or intruded position of $\underline{6}$. This requires further experimental work, coupled with longitudinal study.

CHAPTER FOUR. SYNTHESIS: THE DENTAL ARCHES VIEWED VERTICALLY (FIGS. 6, 8, AND 20)

The position of the upper permanent first molar has been defined in the three planes of space. From the lateral and P-A x-ray films the teeth can be drawn directly. The third view, the vertical view, is missing. From the two films it is possible to reconstruct the mandible and the palate as seen vertically and to draw the teeth as they are situated on their basal bone.

Technique.—As the lateral and P-A tracings are reoriented on the same sheet of millimeter paper, the gonion, located on the lateral tracing, can be projected on the P-A tracing. The distance Go-Pog is measured on the lateral tracing. From the midpoint between Go-Go, this distance is marked on the P-A tracing below Go-Go. This gives us the Pog point. It is then possible to draw the triangle Go-Pog-Go which represents the real mandible.

The distance from $\overline{1}$ to the arch passing through Pog is measured. Then $\overline{1}$ can be replaced on the Go-Pog-Go triangle. Once we have located $\overline{1}$, the whole dental arch can be drawn. The same technique is used for the palate.

This way it is possible to compare the dental arches and their relationship to their supporting bones—the palate and the mandible.

SUMMARY

1. In the present study we have selected the records of 102 children and nine adults from the files of the Philadelphia Center for Research in Child Growth. The children were all of dental stage III C to IV A, with a chronological age range of 11:3 to 13:7. The study is essentially cross sectional.

2. Sample breakdown is as follows: normal occlusion, twenty-four boys and twenty-nine girls; Class II, Division 1 malocclusion, twenty-nine boys and girls, grouped; Class III malocclusion, eleven boys and girls, grouped; nine Negro boys and girls, grouped, with normal occlusion; the nine adults, male and female, grouped, had mixed occlusion.

3. For each case lateral and anteroposterior roentgenographic cephalometric films, taken in the Broadbent-Bolton apparatus, were analyzed, together with dental models. The main comparative analysis, in the present study, is between the groups with normal occlusion and those with Class II, Division 1 malocclusion.

4. In this study we have employed previously defined landmarks and/or end points in the lateral film, but we have presented an entirely new series of such landmarks and/or end points in the P-A film. The aim is to permit a technical and visual correlation between the two views so that any specific structure, such as $\underline{6}$ may be oriented and understood in three planes of space.

5. In the P-A film we have established three main zones (Fig. 4): horizontal (H), unpaired; central (C), vertical in position, unpaired; lateral (L), paired. The major contents of each zone or structure, as seen in the x-ray film, are carefully defined and described.

6. In the lateral film, three zones, in an anteroposterior orientation, are given (Fig. 5): anterior (A), medial (M), and posterior (P).

7. A technique employing millimeter paper is given which permits the orientation of comparable lateral and P-A tracings, in the same child, at the same age. Also, a technique is presented to permit direct comparison of x-ray films (lateral and P-A) with dental models.

8. The position of $\underline{6}$ anteroposteriorly, as seen in the lateral x-ray film, is as follows:

(a) The distance Te-Na = ANS-$\underline{6}$
(b) Position of $\underline{6}$ to the temporal arc (Te) varies directly as does ANS to the anterior arc.
(c) This suggests that $\underline{6}$ position in the arch varies as does position of $\underline{1}$.
(d) The anteroposterior position of $\underline{6}$ is influenced by size of teeth, position of incisors, muscle balance, and the position of the palate in the cephalofacial complex.
(e) The anteroposterior position of $\underline{6}$ is not, as Angle claimed, fixed; hence, it cannot be absolutely basic to an occlusal classification which assumes $\underline{6}$ to be stable and fixed.

9. The position of $\underline{6}$ transversely, as seen in the P-A x-ray films, is as follows:

(a) In normal occlusion its variability is of the order of 1 to 2 mm.
(b) Class II, Division 1 malocclusions tend to have a smaller bimolar dimension, while in Class III the reverse is true.
(c) The bicanine diameter approximates three-fifths of the bimolar diameter, regardless of occlusal category; the Class II, Division 1 is in the lower end of the distribution of total range.
(d) The position of $\underline{6}$ transversely is influenced by both muscular and mandibular function.

10. The position of $\underline{6}$ vertically, as seen in the lateral x-ray film, is as follows:

(a) The vertical variation of $\underline{6}$ is small, of the order of ± 1 mm.
(b) Hence, the position of $\underline{6}$ is relatively very stable in this plane.

11. This study, cross sectional in nature and based upon small samples in some of the occlusal groups, must be tested at least by longitudinal studies and possibly by experimentation.

EMERGENT CONSIDERATIONS AND SUGGESTIONS

A threefold conclusion emerges from this study: first, the dentofacial relationships are not simple, for many causal factors are generally present; second,

there are factors that cannot be evaluated by clinical, direct appraisal of the patient, although many a clinician may have acquired an analytic "sixth sense" through years of experience; third, the lateral x-ray alone is not enough to evaluate the dentofacial complex.

The present findings lead directly to the problems of classification of malocclusion, of diagnosis and differential diagnosis within the same class of malocclusion, and finally of prognosis and treatment.

The classification based on molar relationship may be used only as a gross demarcation between different classes of malocclusion.

The next step is to make a differential etiological diagnosis—morphologic, functional, genetic—of a given case. It is in this area, I feel, that this study brings different *methods of analysis* of some of the most frequent morphologic factors involved.

Prognosis.—One cannot speak about prognosis without inferring extent and limitation of treatment. In orthodontics, it appears that the opinions concerning the limitation of treatment are extremely divergent. One of the causes of this situation is probably the fact that every orthodontist does not use the same appliance therapy. In other words the prognosis in a given case may be good or bad, depending on the use of intraoral forces (Class II elastics), extraoral forces (headcap), or functional forces (activator).

This study is, therefore, a plea to the orthodontic profession not only to consider the individuality of each child and to make a differential diagnosis according to his optimum, but also to select from the armamentorium of orthodontic therapy the best, most economical (in terms of time and means) appliance to correct his defects.

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A CEPHALOMETRIC ASSESSMENT OF PREPARED MANDIBULAR ANCHORAGE

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TRUE anchorage is not available within the mouth, and it is, therefore, resistance ratios which must be calculated." Thus, in summarizing the anchorage problem, Dr. Chester F. Wright[32] strikes a keynote in which the responsive chord has been, and is, an ever-present intensive search by serious-minded orthodontists for a more stable form of anchorage or resistance. The concern for a better source of resistance seems to be associated with the intermaxillary type more than any other anchorage consideration.

McCoy[19] defines intermaxillary anchorage as "where the teeth of one arch are used as the source of resistance to move the teeth of the opposite arch and the force transmitted to the media of attachment through the use of 'intermaxillary elastics.' "

Higley[14] and Strang,[29] in their teachings, both recognize that the term *stationary anchorage* is a relative one, depending on biologic reactions in the anchorage base, and it is their opinion that *resistance to movement* or *resistance to orthodontic forces* is a more adequate expression of the type of anchorage unit that can be established by orthodontic means.

According to Salzmann[25] and Strang,[30] the following natural resistance factors must be considered:

1. The bone in which the teeth are situated. Strang speaks of this bone as a "variable anatomic structure available for resistance, and the most influential of all is the supporting bone of the alveolar process. This may be well calcified and vitally active or it may be lacking in its mineral content and hence be readily broken down under stress."

2. Root area of the teeth. Resistance is directly proportional to root area, all other factors being equal. Strang mentions the number, form, and size of tooth roots and cusps as contributing toward resistance factors.

3. Teeth undergoing active growth offer increased resistance to movement opposite the direction of natural growth.

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This thesis, which was given as a partial fulfillment of the requirements for certification by the American Board of Orthodontics, is being published with the consent and the recommendation of the Board, but it should be understood that it does not necessarily represent or express the opinion of the Board.

4. Muscular pressure can offer active resistance to orthodontic tooth movement.

5. The manner of interlocking cusps can act as resistance to orthodontic tooth movement.

6. Strang also includes as an additional resistance factor the periodontal membrane.

These natural resistance factors are being utilized by many with various shades of efficiency, as indicated by the following examples:

Rohde[24] feels that the lingual arch wire alone is not entirely adequate as a stabilizing agent when elastics are used in the correction of a Class II malocclusion. Since the lingual arch wire rests on an inclined plane, it causes the mandibular incisors to tip labially. Yet, reasonable clinical judgment, strategic use of the time factor (length of time elastics are used), quality of force, and quantity of teeth to be moved may be favorable factors in the use of the lingual arch appliance for resistance in selected cases.

Brodie[3] states that different degrees of resistance may be attained through the tensing of as many fibers of the periodontal membrane as possible, by enlisting as many teeth as are available. He therefore suggests banding all the teeth, using the edgewise arch appliance to gain as much control and stability of the anchor unit as possible.

Moyers and Higley[20] describe the use of a stabilizing plate to establish a resistance unit of both teeth and alveolar structures, thereby eliminating entirely, or in part, complicated mechanisms and extraoral anchorage. Higley[14] strongly feels that other sources of resistance, in addition to the teeth, are needed. His interest is further manifest in a study of orthodontic anchorage possibilities of basal bone and, in the search for a more stable base from which to use intermaxillary force, Gainsforth and Higley[11] went as far as to implant tissue-tolerant alloys into the medullary bones of dogs.

Bedell[1] also stresses the use of tissue-bearing anchorage appliances and demonstrates extensive treatment procedures by such a method.

Recognizing the hazards of intermaxillary reciprocal forces, and leaning more toward the physiologic aspects of tooth movement, Kloehn,[15] Nelson,[21] and Fischer[10] describe the use of the headcap alone as furnishing the most ideal type of tooth movement, in which the mandibular dental arch may be left untouched in the treatment of Class II types of deformities.

In a scientific investigation concerning an analysis of changes in molar relationships, using the headcap as the source of anchorage, Epstein[9] concludes that this method approaches the ideal, since the mandibular molars are undisturbed and consequently no forward tipping movement of these teeth occurs.

"Establish a stationary anchorage on the mandibular arch and guard this zealously," said Angle,[30] to prevent labial tipping of the mandibular incisors and mesial axial perversion of the canines, premolars, and molars. This statement still seems to be the basic premise in the treatment of malocclusions requiring intermaxillary forces, although we now understand that the word

stationary implies the most effective type of resistance rather than a completely fixed unchangeable arrangement. Despite the efforts of conscientious and studious orthodontists toward the establishment of so-called stationary anchorage with the edgewise arch mechanism on the mandibular arch, in a cephalometric appraisal evaluating this type of resistance, Brodie, Downs, Goldstein, and Myer[4] reported that the mandibular molars showed a decided tendency to come forward, while the maxillary teeth remained stationary.

Goldstein and Myer,[12] making further studies in 1940 on Class II treatment, reported that "the lower molars, due to growth, eruption, and the pull of the elastics, go upward and forward, while the resultant of forces on the lower incisors causes them to be tipped downward and forward."

As recently as 1948, Litowitz[17] reported, in a study of movements of certain teeth, that there was a general tendency toward forward movement of mandibular buccal teeth as well as labial movement of mandibular incisors in the treatment of Class II malocclusions. He stated that there is a predominant tendency of these teeth to return to their original pattern relationships after treatment and retention, but this was not positive in every case reported.

It was undoubtedly the attitude and concern toward the aforementioned resistance factors, as well as the desire to maintain an anchorage unit as static as possible, that led to the outgrowth and development of the dynamic form of resistance advocated by Tweed. This form of resistance is better known as *prepared mandibular anchorage,* which fundamentally is the rearrangement of the teeth in the buccal segments of the denture to assume a distal axial inclination, accompanied by a lingual axial inclination of the mandibular incisors correctly situated over basal bone. This arrangement of the mandibular teeth integrated as a unit is said to offer the best possible mechanical resistance against forward displacement. Tweed[31] defines anchorage preparation as "the placing of the mandibular incisors up over the basal bone, or maintaining them on the basal bone, and rearranging the axial inclinations of the teeth in the buccal segments, from cuspid to second molar when possible, in such a manner as to create a toe-hold to combat any tendency toward mesial drift of the teeth in the buccal segments when intermaxillary force is applied." The distal tipping of the buccal teeth and the lingual tipping of the mandibular incisors are brought about by the use of coordinated second order bends and incisor lingual crown torque, incorporated in an edgewise arch wire, together with Class III elastics.

Tweed's method of establishing and maintaining mandibular anchorage has aroused skeptical appraisals, as well as acclaim, from many recognized workers in the field of orthodontics. For example:

Fischer,[10] in an analysis of mandibular anchorage, views the preparation of mandibular anchorage in the treatment of malocclusions as a futile procedure. He maintains that the mandibular teeth come forward, regardless of anchorage preparation, and that there are few Class II, Division 1 cases in which mandibular anchorage can be successfully prepared. In answer to the

problem, Fischer suggests the use of an occipital apparatus for the treatment of practically all types of malocclusions. On the other hand, Lewis[16] advocates and teaches the thorough preparation of mandibular anchorage before the use of Class II mechanics.

Brodie and associates,[3] in a discussion of Tweed's method of treatment, state that an examination of histologic material prepared from living tissues around moving teeth would show that there is no mechanical device that can add to the resisting power of a tooth beyond the degree represented by the undisturbed tooth.

Strang,[29] while very cognizant of the nonbiologic approach to anchorage preparation, still feels that positive clinical proof of successful end results warrants the acceptance of anchorage preparation as a desirable orthodontic procedure.

Buchner[5] feels that lingual crown torque and second order bends break down mandibular anchorage, instead of furnishing any resistance to displacement.

Still, clinical orthodontists, such as Schudy,[26] write that tipping the mandibular teeth back to an upright position before Class II elastics are applied prevents the mandibular teeth from moving forward.

Carey,[6] in discussing space closure, feels that anchorage will be enhanced by first tipping back the posterior teeth.

In a paper dealing with fundamentals of Tweed concepts, Shelden[27] states that *anchorage* remains the biggest word in mechanical orthodontics, and emphasizes Tweed's contention that all mandibular incisors should be carried at least to an upright axial inclination, together with a slight distal tipping of the anchor teeth. This locates them in a most favorable position to withstand any tendency to be displaced further forward. However, Porter[23] poses the question of muscle balance as related to the uprighting and lingual movement of the mandibular incisors over medullary bone, and feels that muscular pressures, particularly those of the tongue, may upset the incisor position after treatment.

Since such an interesting variety of opinions exists regarding the methods and clinical application of prepared mandibular anchorage, this study has been undertaken to investigate the quality of resistance or anchorage obtainable through the process of mandibular anchorage preparation.

In order to ascertain the degree of stability of the mandibular teeth under the influence of Class II elastics, after anchorage has been prepared, investigations were made of the following:

1. Changes in the axial inclination of the mandibular left central incisor before treatment, before and after anchorage preparation, before and after Class II mechanics, at the completion of treatment, and after a retentive period of one to three years.

2. Changes in crown and root position of the mandibular left central incisor during all stages of treatment listed under No. 1.

3. Changes in crown and root position of the mandibular left first permanent molar during all stages of treatment listed under No. 1.

MATERIALS AND METHODS

To accomplish the above objectives, records were made which included cephalometric headplates taken in sequence before treatment, before and after mandibular anchorage preparation, before and after Class II mechanics, after treatment, and one to three years after retention had been discontinued.

The entire study is comprised of 140 cephalometric roentgenograms of thirty-six successfully treated cases. These patients were treated in my own office with the edgewise arch mechanism, in accordance with the methods advocated by Tweed. A series of 222 tracings were made following the methods of Margolis[18] and Downs.[8] Eighty-two of these tracings were composites of two or more profile x-ray pictures. The malocclusions were divided as follows:

Twenty-five patients—Class II, Division 1

Three patients—Class II, Division 2

Eight patients—Class I

In eight of these thirty-six cases extraction therapy was employed and mandibular anchorage was prepared. In these extraction cases, all comparisons with subsequent x-ray pictures were made with profile headplates taken after space closure.

The following well-established points and landmarks were used:

1. Mandibular symphysis
2. Lower border of the mandible

The lines drawn in this study were:

1. Mandibular plane—a line drawn tangent to the most inferior border of the mandible.

2. AP line (anterior perpendicular)—a line drawn perpendicular to the mandibular plane and tangent to the most anterior part of the symphysis.

3. A line through the long axis of the mandibular left central incisor at the mid-point of the incisal edge and root apex extended to the mandibular plane.[18]

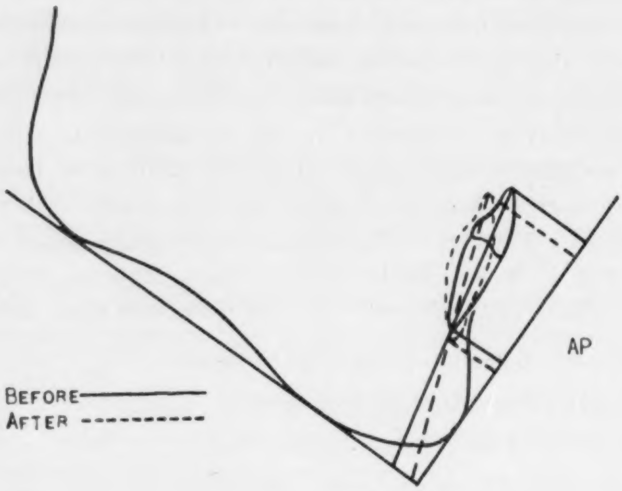
4. LM line[17] (long axis mandibular plane line)—a line drawn through the mid-point of the crown and roots of the mandibular left first permanent molar and extended to the mandibular plane.

The angular measurements used the incisor mandibular plane angle[18] formed by a line drawn through the long axis of the mandibular left central incisor and the mandibular plane.

The linear measurements of the crowns and roots of the mandibular incisors and molars were made by means of superposition of the mandibles on

the symphysis, mandibular planes, and the AP planes, the measurements being made on a line parallel to the mandibular plane, recording the changes in distance to the AP line.

Fig. 1.



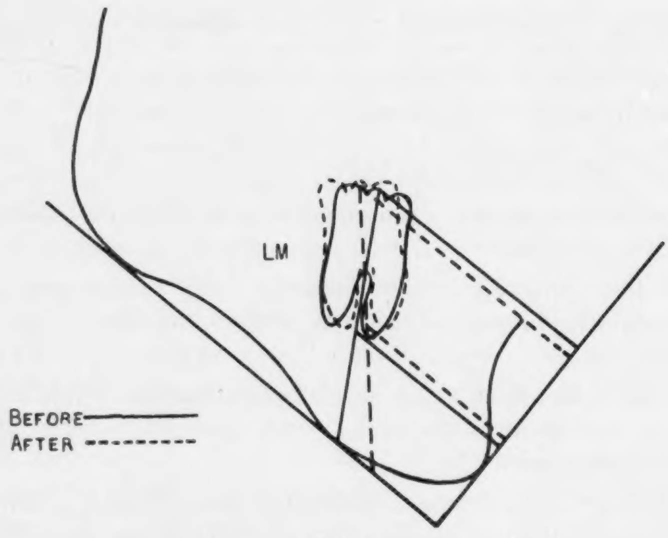


Fig. 2.

Figs. 1 and 2.—Tracings illustrating the method of measuring the changes in position of crowns and roots of mandibular incisors and molars. The difference in distance of the incisor and molar mid-axis lines at the crown and root apex of incisors and molars to the anterior perpendicular (*AP* line) parallel to the mandibular plane is recorded. Distal movement is designated as minus, mesial movement as plus.

The linear measurements recorded changes in positions of (1) crowns and root apices of mandibular central incisors and (2) crowns and root apices of mandibular first permanent molars.

In the tracings, labial or mesial movements of crowns and roots are shown as +, and lingual or distal movements of crowns and roots are shown as –. The measurements are recorded in millimeters.

Of fifteen cases investigated, fourteen exhibited an increase in axial inclination of the mandibular incisors during Class II mechanics when compared to their position after anchorage preparation. However, it is noteworthy that, after Class II mechanics, the mandibular incisors of eleven cases were less procumbent than before anchorage preparation. While one case showed no change, three exhibited a greater degree of axial inclination.

Table I. Variations in Axial Inclination of the Mandibular Incisors Before and After Mandibular Anchorage Preparation and After Class II Elastic Therapy (Fifteen Cases)

CASE NO.	BA (DEGREES)	AA (DEGREES)	AC (DEGREES)
1	81	69	83
2	89	80	85
7	89	85.5	79
11	89	82	87.5
16	86	78	81.5
18	83	80	90
21	98.5	85	94
22	90	82	87
23	86	79	82
30	105	88.5	96
31	106	88	98
32	99	82	95
33	95	86	95
34	107	82.5	91
35	86	76	88
Average	92.6	81.5	88.8

BA = Before anchorage preparation.
AA = After anchorage preparation.
AC = After Class II mechanics.

AFTER ANCHORAGE PREPARATION COMPARED WITH BEFORE ANCHORAGE PREPARATION	AFTER CLASS II MECHANICS COMPARED WITH AFTER ANCHORAGE PREPARATION			AFTER CLASS II MECHANICS COMPARED WITH BEFORE ANCHORAGE PREPARATION		
	DECREASE	INCREASE	NO CHANGE	DECREASE	INCREASE	NO CHANGE
Decrease 15	1	14		11	3	1

Chart 1.—An analysis of Table I showing changes in axial inclination of the mandibular incisors before and after mandibular anchorage preparation and after the influence of Class II elastic therapy.

Significant averages taken from Table I give evidence of a reduction in axial inclination of the mandibular incisors from 92.6 degrees before anchorage preparation to 81.5 degrees after anchorage preparation was completed, or a decrease of 11.1 degrees in the incisor-mandibular plane angle.

After Class II mechanics exacted its toll on the prepared mandibular teeth, axial inclinations increased an average of 7.3 degrees, resulting in an incisor-mandibular plane angle of 88.8 degrees.

The net result after Class II mechanics, as compared to before anchorage preparation, showed that the incisor mandibular plane angle averaged 3.8 degrees less (or a more lingual position of the incisors).

Nonextraction cases were selected to demonstrate the changes in the incisor-mandibular plane angle before and after treatment. It was thought that

TABLE II. VARIATIONS IN AXIAL INCLINATION OF THE MANDIBULAR INCISORS BEFORE AND AFTER TREATMENT WHERE MANDIBULAR ANCHORAGE WAS PREPARED AND SUBJECTED TO CLASS II ELASTICS (TWENTY-SEVEN CASES, NONEXTRACTION)

CASE NO.	B (DEGREES)	A (DEGREES)
1	81	86
3	86	84
4	86	84
5	89	82.5
6	90	89
7	90	79
8	90.5	91
9	91	83
10	91	85
11	91	94.5
12	92	85
13	92.5	95
14	94	88
15	94.5	85
17	95.5	87
19	97	91
20	97.5	82
21	98	94
24	101	92
25	101	93
26	101	91.5
28	103	99
30	105	96
31	106	98
32	107	95
33	107	90
34	107	91
Average	95.7	89.3

B = Before treatment.
A = After treatment.

TABLE III. VARIATIONS IN AXIAL INCLINATION OF THE MANDIBULAR INCISORS AFTER INCISOR RETRACTION AND AFTER TREATMENT IN EIGHT EXTRACTION CASES WHERE MANDIBULAR ANCHORAGE WAS PREPARED

CASE NO.	B (DEGREES)	AIR (DEGREES)	A (DEGREES)
2	83	89	85
16	95	86	81.5
18	96	83	90
22	100	90	87
23	100	86	82
27	102	92	95
29	104.5	83.5	87
35	88.5	86	88
Average	96.1	86.9	86.9

B = Before treatment.
AIR = After incisor retraction.
A = After treatment.

AFTER INCISOR RETRACTION COMPARED WITH BEFORE TREATMENT		AFTER TREATMENT COMPARED WITH AFTER INCISOR RETRACTION			AFTER TREATMENT COMPARED WITH BEFORE TREATMENT		
		DECREASE	INCREASE	NO CHANGE	DECREASE	INCREASE	NO CHANGE
Decrease	7	3	4		7		
Increase	1	1				1	

Chart 2.—An analysis of Table III showing changes in axial inclination of the mandibular incisors before treatment, after incisor retraction, and after treatment in eight extraction cases where mandibular anchorage was prepared (after closure of all spaces).

cases in this category could more adequately prove the advantages or disadvantages of prepared mandibular anchorage.

Of the twenty-seven cases listed in Table II showing changes in axial inclination of the mandibular incisors before and after treatment where anchorage had been prepared, twenty-three had a decrease in the incisor mandibular plane angle after treatment; the average decrease being 6.4 degrees.

In this series of nonextraction cases, the changes in the axial inclination of the mandibular incisors before and after treatment may be attributed, in part, to the preliminary closure of the anterior spaces before mandibular anchorage preparation.

Anchorage was prepared in those cases where the space provided for by extractions was insufficient to both upright the incisors and correct the mesiodistal arch discrepancies.

Of the eight extraction cases, four showed an average increase of 4 degrees in the incisor-mandibular plane angle, and four an average decrease of 4 degrees after treatment as compared with after incisor retraction.

TABLE IV. VARIATIONS IN AXIAL INCLINATION OF THE MANDIBULAR INCISORS BEFORE AND AFTER TREATMENT AND AFTER RETENTION WHERE MANDIBULAR ANCHORAGE WAS PREPARED AND SUBJECTED TO CLASS II ELASTICS (FOURTEEN CASES)

CASE NO.	B (DEGREES)	A (DEGREES)	AR (DEGREES)
4	86	84	85
5	89	82.5	86
8	90.5	91	91
9	91	83	85
10	91	85	88.5
12	92	85	87
13	92.5	95	91
14	94	88	90
15	94.5	85	87
20	97.5	83	82
24	101	92	92
25	101	93	92
31	106	98	101
34	107	91	91
Average	95.2	88.3	89.1

B = Before treatment.
A = After treatment.
AR = After retention.

AFTER TREATMENT COMPARED WITH BEFORE TREATMENT		AFTER RETENTION COMPARED WITH AFTER TREATMENT			AFTER RETENTION COMPARED WITH BEFORE TREATMENT		
		DECREASE	INCREASE	NO CHANGE	DECREASE	INCREASE	NO CHANGE
Decrease	12	2*	8†	2	12		
Increase	2	1†		1	1	1	

*Moved in direction of treatment.
†Moved toward original position.

Chart 3.—An analysis of Table IV showing changes in axial inclination of the mandibular incisors before and after treatment, and after retention, where mandibular anchorage was prepared.

After treatment twelve of the fourteen cases disclosed a smaller incisor-mandibular plane angle than before treatment. One to three years after retention a tendency was exhibited in eight of the twelve cases for the incisors to become more procumbent, moving toward their original positions. In this instance, the axial inclination of the mandibular incisors increased from an

average of 88.3 degrees to 89.1 degrees. It is important to note that the mandibular incisors of all but one case were still less procumbent than before treatment began, the average decrease in the incisor-mandibular plane angle being 6.1 degrees.

TABLE V. LINEAR MEASUREMENTS OF CROWN AND ROOT MOVEMENTS OF THE MANDIBULAR INCISORS BEFORE AND AFTER ANCHORAGE PREPARATION AND AFTER CLASS II ELASTIC THERAPY (FIFTEEN CASES)

CASE NO.	CROWN AA (MM.)	CROWN AC (MM.)	ROOT APEX AA (MM.)	ROOT APEX AC (MM.)
1	−2.5	+2	+3	+1.5
2	−2.5	0	0	0
7	−2.5	−3.5	−1	+1
11	−1.5	−1.5	+1.5	0
16	−3	−0.5	+0.5	−0.5
18	−1	+3	+1	+1
21	−2.5	0	+3	+2
22	−3	0	0	+1
23	−2.5	0	+1.5	+2.5
30	−5	0	+2.5	0
31	−5	−2.5	+1.5	+1.5
32	−6	−2	+4	+2.5
33	−6	−3	+2.5	+2
34	−10	−5	+3	+3
35	−1	0	+3.5	0
Average	−3.6	−0.9	+1.8	+1.2

AA = After anchorage preparation. − = Lingual.
AC = After Class II elastics. + = Labial.

AFTER ANCHORAGE PREPARATION COMPARED WITH BEFORE ANCHORAGE PREPARATION		AFTER CLASS II MECHANICS COMPARED WITH AFTER ANCHORAGE PREPARATION			AFTER CLASS II MECHANICS COMPARED WITH BEFORE ANCHORAGE PREPARATION		
		LINGUAL	LABIAL	NO CHANGE	LINGUAL	LABIAL	NO CHANGE
Crowns							
Lingual	15	1	13	1	7	2	6
Roots							
Lingual	1		1			1	
Labial	12	8	1	3	1	8	3
No change	2		1	1		1	1
Bodily movement							
Lingual	1						

Chart 4.—An analysis of Table V showing linear movements of crowns and roots of mandibular incisors before and after anchorage preparation and after the influence of Class II elastic therapy.

Following the investigation of axial inclination of the mandibular incisors in various stages of treatment, after treatment, and after retention, it became necessary to recognize the fact that changes in axial inclination may be accomplished by tipping, bodily movement of the crowns, root apices, or both.

The linear measurements of the labial and lingual movements of the crowns and root apices of the mandibular incisors under the influence of Class III and Class II mechanics were examined in three groups. All were analyzed for tipping and bodily movements.

The first group consisted of fifteen cases studied (1) before mandibular anchorage preparation, (2) after mandibular anchorage preparation (Class III mechanics), and (3) after Class II mechanics.

The second group consisted of twenty-eight cases analyzed (1) before treatment and (2) after treatment.

The third group was comprised of fifteen cases investigated (1) before treatment, (2) after treatment, and (3) after retention (one to three years).

TABLE VI. LINEAR MEASUREMENTS OF CROWN AND ROOT MOVEMENTS OF THE MANDIBULAR INCISORS BEFORE AND AFTER TREATMENT WHERE MANDIBULAR ANCHORAGE WAS PREPARED AND SUBJECTED TO CLASS II ELASTIC THERAPY (TWENTY-EIGHT CASES)

CASE NO.	CROWN A (MM.)	ROOT APEX A (MM.)
1	+2	0
3	–4	–3
4	–2.5	0
5	–2.5	0
6	0	–1
7	–2.5	+1
8	–0.5	–2.5
9	–2	+1.5
10	–5.5	–4
11	–2	–2
12	–3	0
13	+2.5	+1
14	–1	+1
15	–3	0
17	–2.5	0
20	–8.5	–3
21	0	+1.5
24	+0.5	+4
25	–4	–1
26	–3	+2
27	0	+2.5
28	0	+1
29	0	–1.5
30	–0.5	+2.5
31	–3	+1
32	–2.5	+2
33	–5	–1
34	–5	+3
Average	–2.4	+0.2

A = After treatment.
- = Lingual.
+ = Labial.

Crowns	*After treatment*
Moved lingually	20
Moved labially	3
No change	5

The crowns of almost all cases were more lingual after treatment when compared with their positions before treatment

Roots	*After treatment*
Moved lingually	9
Moved labially	13
No change	6

Bodily movement	*After treatment*
Moved lingually	7
Moved labially	2

Of the combined crown and root movements, nine of the twenty-eight cases moved bodily.

Chart 5.—An analysis of Table VI showing linear movements of crowns and roots of the mandibular incisors before and after treatment where mandibular anchorage was prepared and subjected to Class II elastic therapy.

The calculations were recorded in millimeters, and the distances of the crown and root apices were measured from the anterior perpendicular line. Labial movements were recorded as + and lingual as –. All movements of the crowns and root apices were compared to their original positions.

TABLE VII. LINEAR MEASUREMENTS OF CROWN AND ROOT MOVEMENTS OF THE MANDIBULAR INCISORS BEFORE AND AFTER TREATMENT AND AFTER RETENTION WHERE MANDIBULAR ANCHORAGE WAS PREPARED AND SUBJECTED TO CLASS II ELASTIC THERAPY (FIFTEEN CASES)

CASE NO.	CROWN		ROOT APEX	
	A (MM.)	AR (MM.)	A (MM.)	AR (MM.)
4	–2.5	–1	0	0
5	–2.5	–2.5	0	–2
6	0	+1.5	–1	–1.5
8	–0.5	–2	–2.5	–1.5
9	–2	–2	+1.5	+1.5
10	–5.5	–6.5	–4	–5.5
12	–3	–2.5	0	0
13	+2.5	+0.5	+1	+1
14	–1	–0.5	+1	+0.5
15	–3	–2.5	0	–2
20	–8.5	–10	–3	–3.5
24	+0.5	–1.5	+4	+3
25	–4	–4	–1	0
31	–3	–1.5	+1	+1
34	–5	–4.5	+3	+3.5
Average	–2.5	–2.6	0	–0.3

A = After treatment. – = Lingual.
AR = After retention. + = Labial.

AFTER TREATMENT COMPARED WITH BEFORE TREATMENT		AFTER RETENTION COMPARED WITH AFTER TREATMENT			AFTER RETENTION COMPARED WITH BEFORE TREATMENT		
		LINGUAL	LABIAL	NO CHANGE	LINGUAL	LABIAL	NO CHANGE
Crowns							
Lingual	12	3*	6†	3	12		
Labial	2	1†	1*		1	1	
No change	1		1			1	
Roots							
Lingual	5	2*	2†	1	4		1
Labial	6	2†	1*	3		6	
No change	4	2		2	2		2
Bodily movement							
Lingual	4						
Labial	2						

*Moved in direction of treatment.
†Moved toward original position.

Chart 6.—An analysis of Table VII showing linear movements of crowns and roots of the mandibular incisors before and after treatment and after retention where mandibular anchorage was prepared.

The crowns of all cases moved lingually after anchorage preparation, but during Class II mechanics almost all moved in a labial direction. It is significant that after Class II mechanics the crowns were still lingual or showed no change as related to the original position, with only two crowns being more labial, which may indicate good resistance to the forward pull of elastics.

The root apices of twelve cases moved labially after anchorage preparation. During Class II mechanics eight of these twelve moved lingually toward

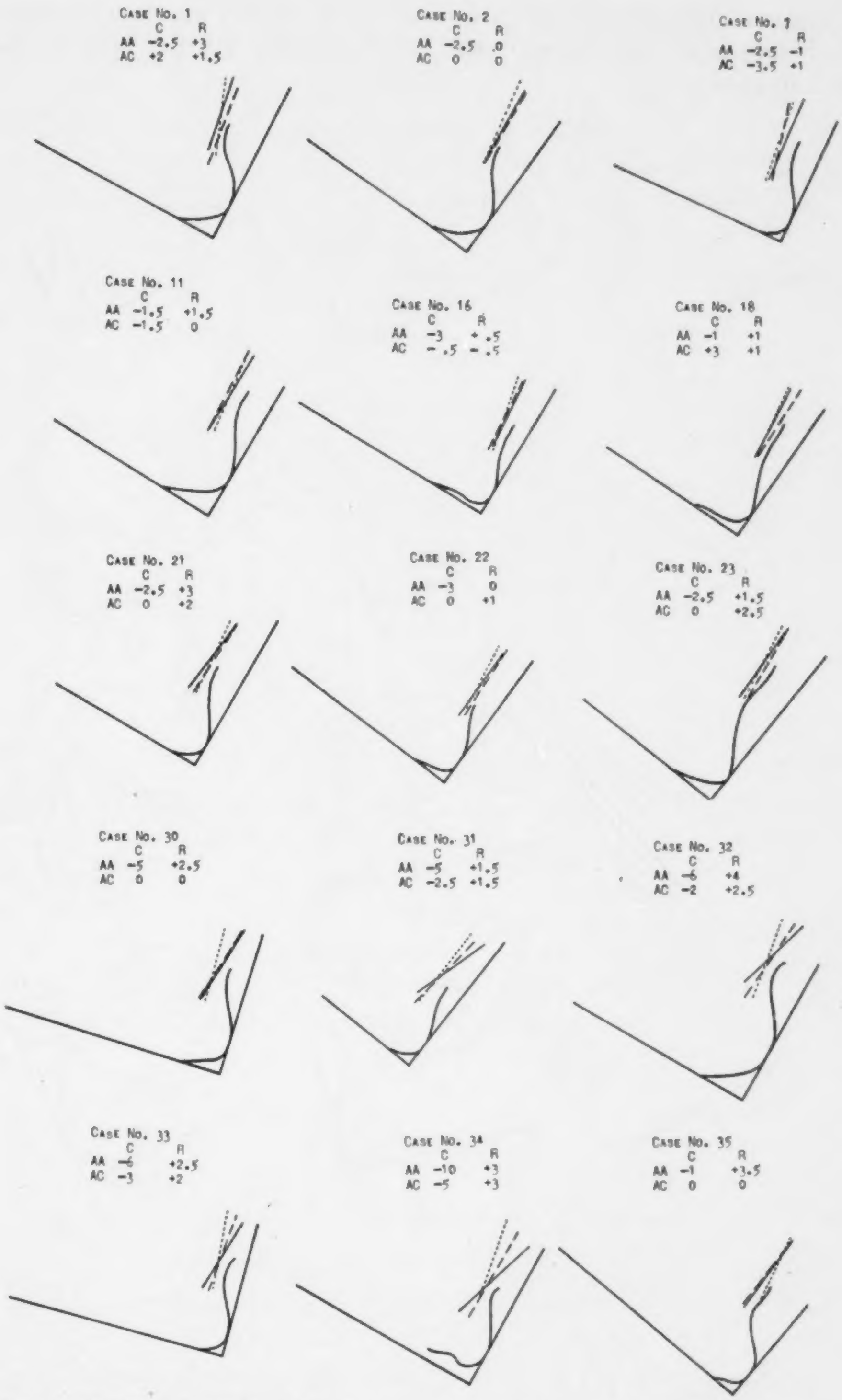


Fig. 3.—Tracings illustrating changes in axial inclinations and movements of crowns and roots of mandibular incisors before and after anchorage preparation and after Class II mechanics. (Refer to Table V.)

———, Before anchorage preparation; *AA* after anchorage preparation (. . . .); *AC*, after Class II mechanics (- - - -); *C*, crown; *R*, root apex; −, lingual; +, labial.

their original positions. Finally, comparing these root apices with their positions before treatment, ten were still labial, and five either showed no change or were lingual.

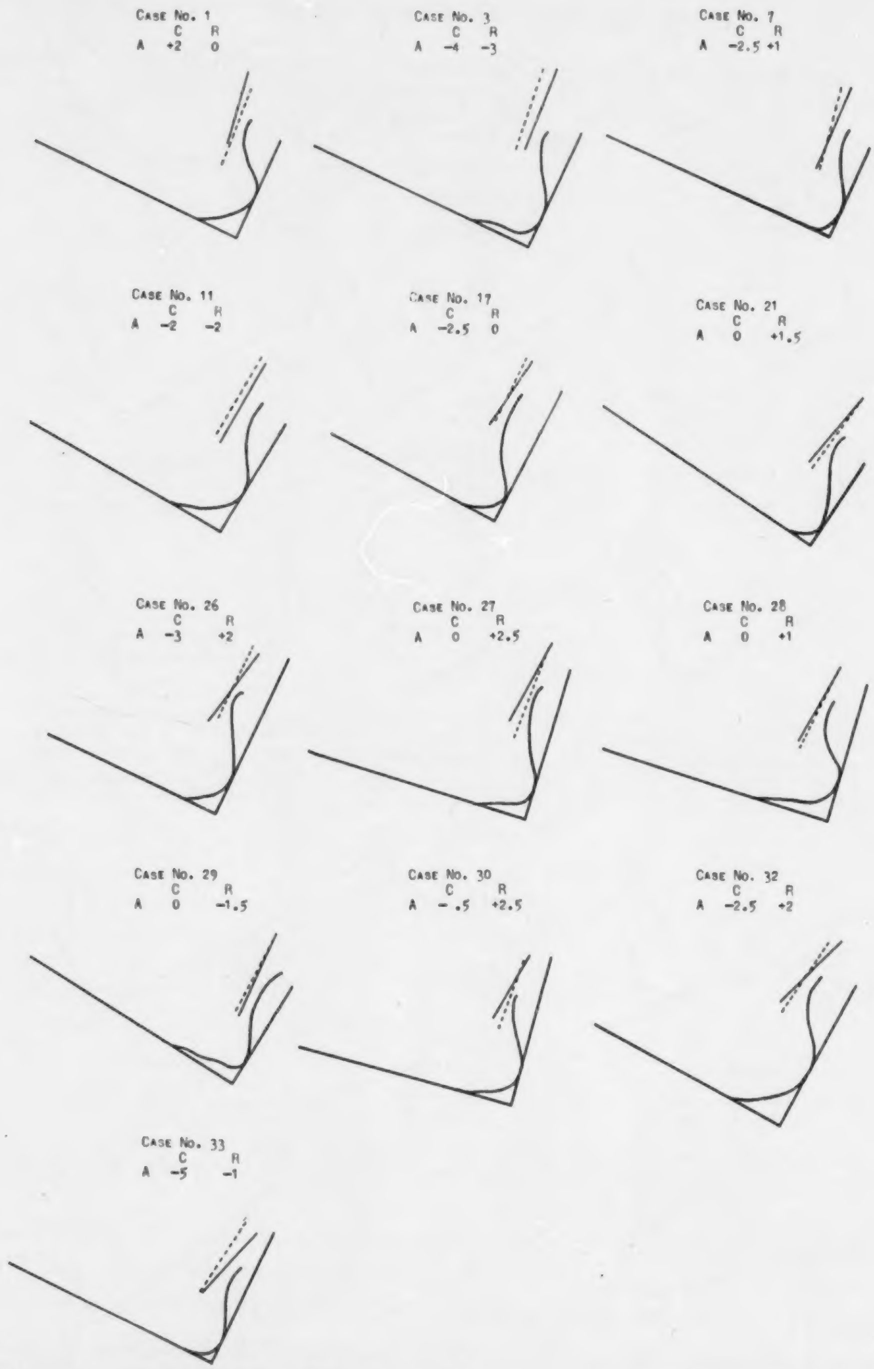


Fig. 4.—Tracings illustrating changes in axial inclinations and movements of crowns and roots of mandibular incisors before and after treatment where mandibular anchorage has been prepared. (Refer to Table VI.) (The remainder of cases in this group are included in Fig. 5.) ———, Before treatment; *A*, after treatment (. . . .); *C*, crown; *R*, root apex; −, lingual; +, labial.

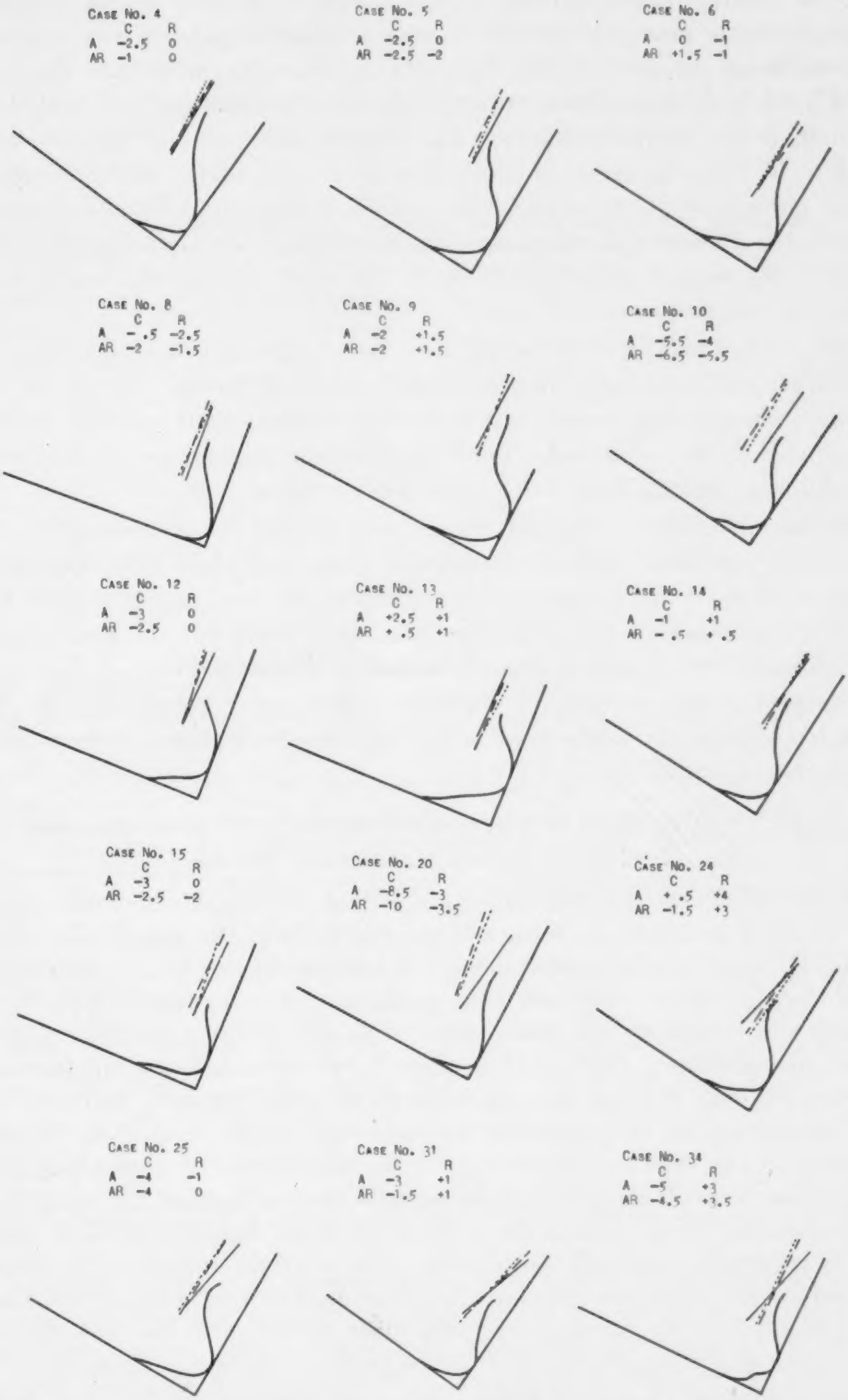


Fig. 5.—Tracings illustrating changes in axial inclinations and movements of crowns and roots of mandibular incisors before and after treatment and after retention. Prepared mandibular anchorage was the resistance factor employed. (Refer to Table VII.)

———, Before treatment; *A*, after treatment (. . . .); *AR*, after retention (- - - -); *C*, crown; *R*, root apex; –, lingual; +, labial.

This analysis again confirms previous results wherein a lingual tipping of the crown is generally combined with a labial tipping of the root apex. In a significant number of cases the roots did move lingually with the crown, resulting in lingual bodily movement. In those cases in which both crown and root moved lingually, the average lingual movement of the crown was found to be twice as great as the lingual movement of the root. Where the lingual movement of the crown was combined with the labial movement of the root, the distances in either direction were about the same. In those cases in which the root remained stationary, the least amount of lingual crown movement was observed.

As noted in the previous tables, here also the crowns of most of the cases after treatment were more lingual than before treatment. Again the same tendency, wherein the crowns moved labially toward their original positions after retention, was observed. Yet it was evident that almost all the crowns were still more lingual than their positions before treatment.

Labial movement of the root apices was evident in six cases after treatment when compared with their original positions, while nine were either lingual or showed no change. After retention the root apices in only three cases were more labial than they were after treatment, and the root apices of the remaining twelve cases were more lingual or unchanged.

Comparing the position of the root apices after retention with their original positions, six cases were labial and the remaining nine were either lingual or unchanged.

PREFACE TO THE STUDY OF LINEAR MEASUREMENTS OF CROWN AND ROOT MOVEMENTS OF THE MANDIBULAR MOLARS

A review of the literature shows a strong relationship between the activity of the mandibular incisors and the reactions of the mandibular molars to Class III and Class II elastic force. The alterations of their position, both during the time these teeth are being made available for resistance purposes and also subsequent to retention, seem to show a similar behavior pattern. Brodie[2] demonstrated similar tendencies between mandibular incisors and molars concerning changes in axial inclination after treatment and retention. Cole[7] indicated that the increased procumbency of the mandibular incisors is related to the forward movement of the mandibular molars after retention. It was decided, therefore, to investigate the reactions of the mandibular first permanent molar during the process of anchorage preparation, during Class II treatment, and after retention. The analysis included (1) thirteen cases before and after mandibular anchorage preparation, and after Class II mechanics, (2) thirty cases before and after treatment,* and (3) fourteen cases before and after treatment and one to three years after retention.

The crowns of almost all mandibular first molars moved distally during anchorage preparation. Only one moved mesially, and no explanation can be given for this. The "prepared" mandibular denture during Class II mechanics

*Six cases were incomplete for this portion of the study.

exhibits forward movement of the mandibular molars in all but three instances, and these demonstrate no change from the position which they occupied after anchorage preparation. On comparison with the position of the mandibular first molars before anchorage preparation, eight of the thirteen cases investigated were still distal or showed no change. Five, however, moved mesially.

TABLE VIII. LINEAR MEASUREMENTS OF CROWN AND ROOT MOVEMENTS OF THE MANDIBULAR MOLARS BEFORE AND AFTER ANCHORAGE PREPARATION AND AFTER CLASS II ELASTIC THERAPY (THIRTEEN CASES)

CASE NO.	CROWN AA (MM.)	CROWN AC (MM.)	ROOT APEX AA (MM.)	ROOT APEX AC (MM.)
2	–2.5	–1	+3	0
7	–3	–3	+2	+2
11	+1	+1	+1.5	+1.5
16	–1	0	0	0
18	0	+1	–1	–3
21	–2.5	0	0	+2.5
22	–3	+1.5	–2.5	–2.5
23	0	0	+2	0
30	–4.5	+2	0	+2.5
31	–5	–0.5	+4	0
33	–1.5	+2	+6	+6
34	–7	–2.5	0	+9
35	–1.5	0	0	+1.5
Average	–2.4	0	+1.2	+1.5

AA = After anchorage preparation. – = Distal.
AC = After Class II elastics. + = Mesial.

AFTER ANCHORAGE PREPARATION COMPARED WITH BEFORE ANCHORAGE PREPARATION		AFTER CLASS II MECHANICS COMPARED WITH AFTER ANCHORAGE PREPARATION			AFTER CLASS II MECHANICS COMPARED WITH BEFORE ANCHORAGE PREPARATION		
		DISTAL	MESIAL	NO CHANGE	DISTAL	MESIAL	NO CHANGE
Crowns							
Distal	10		9	1	4	3	3
Mesial	1			1		1	
No change	2		1	1		1	1
Roots							
Distal	2	1		1	2		
Mesial	6	3		3		3	3
No change	5		4	1		4	1
Bodily movement							
Distal	1						
Mesial	1						

Chart 7.—An analysis of Table VIII showing linear movements of crowns and roots of the mandibular molars before and after anchorage preparation and after the influence of Class II elastic therapy.

One-half of the mandibular molar root apices moved mesially during mandibular anchorage preparation, and most of the others showed no change from their position before mandibular anchorage preparation. After Class II elastic pull, the net result showed more than one-half of the root apices mesial to their positions before anchorage preparation.

Two of the thirteen cases investigated showed bodily movement after anchorage preparation, one mesial and one distal. No definite trends in bodily movement were noted in this table.

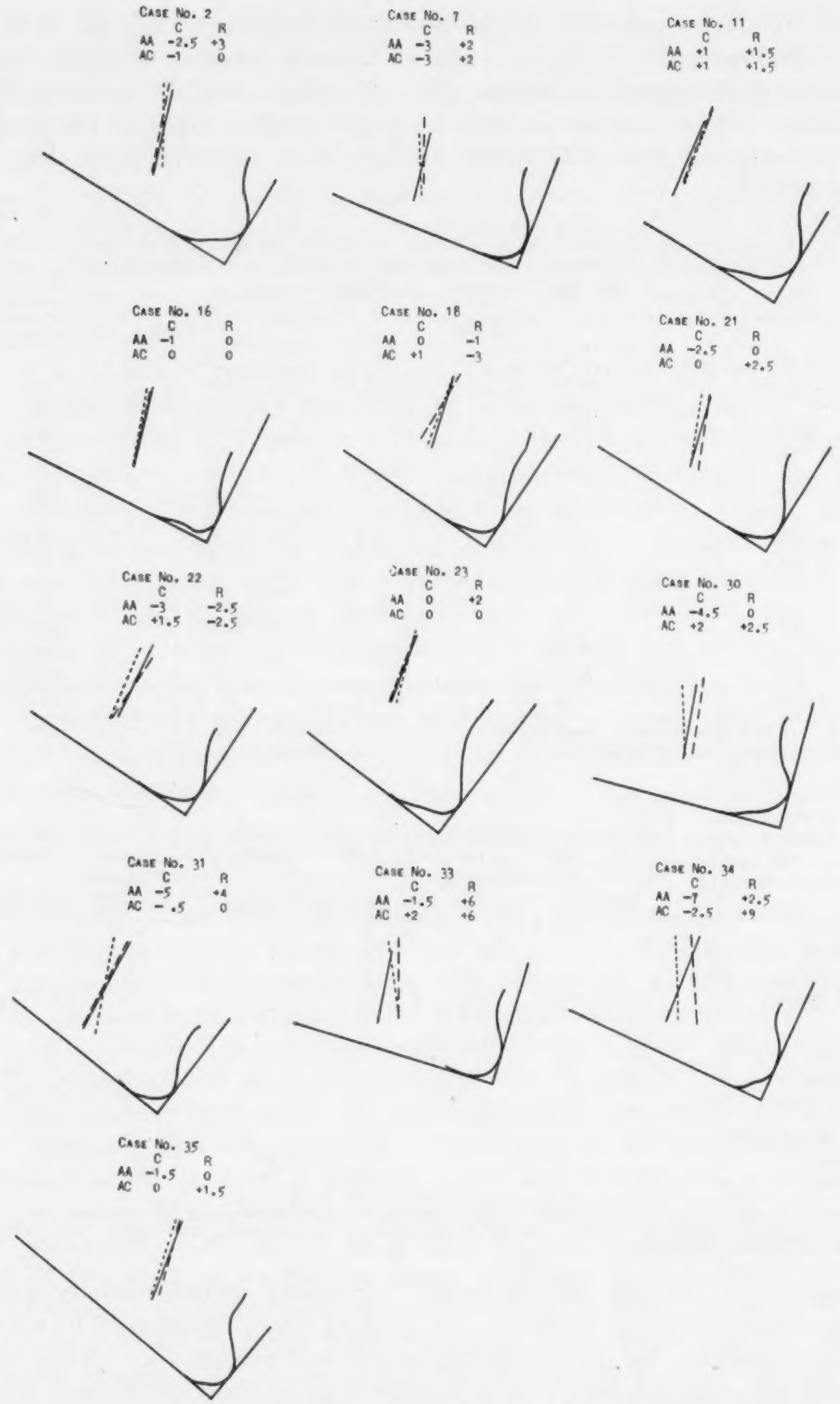


Fig. 6.—Tracings illustrating the movement of crowns and roots of the mandibular first molar before and after mandibular anchorage preparation and after Class II mechanics. (Refer to Table VIII.)

———, Before anchorage preparation; *AA*, after anchorage preparation (. . . .); *AC*, after Class II mechanics (- - - -); *C*, crown; *R*, root apex; –, distal; +, mesial.

Of thirty cases after treatment in which the mandibular molars were subjected to Class II elastic therapy on the prepared mandibular denture, twenty-five had a distal axial inclination. In fifteen of the twenty-five cases, the crowns were distal and the roots were mesial or showed no change. Roots were mesial in ten cases, and crowns were in various positions. However, the teeth in every case had a distal axial inclination. Three cases showed no change in the combined crown and root position from their original positions, and two had a mesial axial inclination.

TABLE IX. LINEAR MEASUREMENTS OF CROWN AND ROOT MOVEMENTS OF THE MANDIBULAR MOLARS BEFORE AND AFTER TREATMENT WHERE MANDIBULAR ANCHORAGE WAS PREPARED AND SUBJECTED TO CLASS II ELASTIC THERAPY (THIRTY CASES)

CASE NO.	CROWN A (MM.)	ROOT APEX A (MM.)
2	-3.1	-2
3	-2.5	0
4	0	+1
5	-7	-2.5
6	-6	0
7	-2	+2
8	0	+1
9	+2.5	+3
10	-2	+2
11	0	+2.5
12	-3.5	+3
13	-1	+2.5
14	-2	+3
15	-1	+5
16	0	0
17	-1.5	+2
18	+1	-3
21	0	+3.5
22	+1.5	-2.5
23	0	0
24	-3	+7.5
25	-1	+2
28	+2	+2.5
29	-1	0
30	-2	0
31	0	0
32	+2	+5
33	+2	+4.5
34	-2	+9
35	-1.5	0
Average	-1	+1.7

A = After treatment.
- = Distal.
+ = Mesial.

CROWNS		ROOTS		COMBINED CROWN AND ROOT MOVEMENTS		
Distal	17	Distal	4	*Crown*	*Root*	
Mesial	6	Mesial	18	Distal	Mesial	10
No change	7	No change	8	Distal	No change	5
				No change	Mesial	4
				Mesial	Mesial	4
				No change	No change	3
				Distal	Distal	2
				Mesial	Distal	2

Chart 8.—An analysis of Table IX showing linear movements of crowns and roots of the mandibular molars before and after treatment where mandibular anchorage was prepared and subjected to Class II elastics.

TABLE X. LINEAR MEASUREMENTS OF CROWN AND ROOT MOVEMENTS OF THE MANDIBULAR MOLARS BEFORE AND AFTER TREATMENT AND AFTER RETENTION WHERE MANDIBULAR ANCHORAGE WAS PREPARED AND SUBJECTED TO CLASS II ELASTIC THERAPY (FOURTEEN CASES)

CASE NO.	CROWN A (MM.)	CROWN AR (MM.)	ROOT APEX A (MM.)	ROOT APEX AR (MM.)
4	0	0	+1	+2
5	–7	–4.5	–2.5	0
6	–6	–3	0	–4
8	0	–2	+1	+1
9	+2.5	+3.5	+3	+3
10	–2	0	+2	+3.5
12	–3.5	–3	+3	+3.5
13	–1	+1	+2.5	+2.5
14	–2	0	+3	+3
15	–1	–2.5	+5	+3
24	–3	–1	+7.5	+6.5
25	–1	–1	+2	–1
31	0	–2	0	+1.5
34	–2	–1	+9	+4
Average	–1.9	–1.1	+2.6	+2

A = After treatment. – = Distal.
AR = After retention. + = Mesial.

AFTER TREATMENT COMPARED WITH BEFORE TREATMENT		AFTER RETENTION COMPARED WITH AFTER TREATMENT			AFTER RETENTION COMPARED WITH BEFORE TREATMENT		
		DISTAL	MESIAL	NO CHANGE	DISTAL	MESIAL	NO CHANGE
Crowns							
Distal	10	1*	8†	1	7	1	2
Mesial	1		1*			1	
No change	3	2		1	2		1
Roots							
Distal	1		1†				1
Mesial	11	4†	3*	4	1	10	
No change	2	1	1		1	1	

*Moved in direction of treatment.
†Moved toward original position.

Chart 9.—An analysis of Table X showing linear movements of crowns and roots of the mandibular molars before and after treatment and after retention where mandibular anchorage was prepared.

After treatment, the molars in four cases moved forward bodily, though still retaining a distal axial inclination, and two tipped forward from their initial positions. The remaining twenty-four cases were either distal or no further forward than their positions at the beginning of treatment.

After treatment the crowns of the mandibular molars in ten cases were distal to their original position. After retention most of these crowns showed an inclination to upright or return toward their original positions. It is interesting to note, however, that in only two instances were the crowns forward from their original position.

After treatment the root apices of eleven cases were mesial to their original position, although a few of these, after retention, exhibited a tendency to revert toward their initial position. Finally, after retention almost all roots were mesial to their original position.

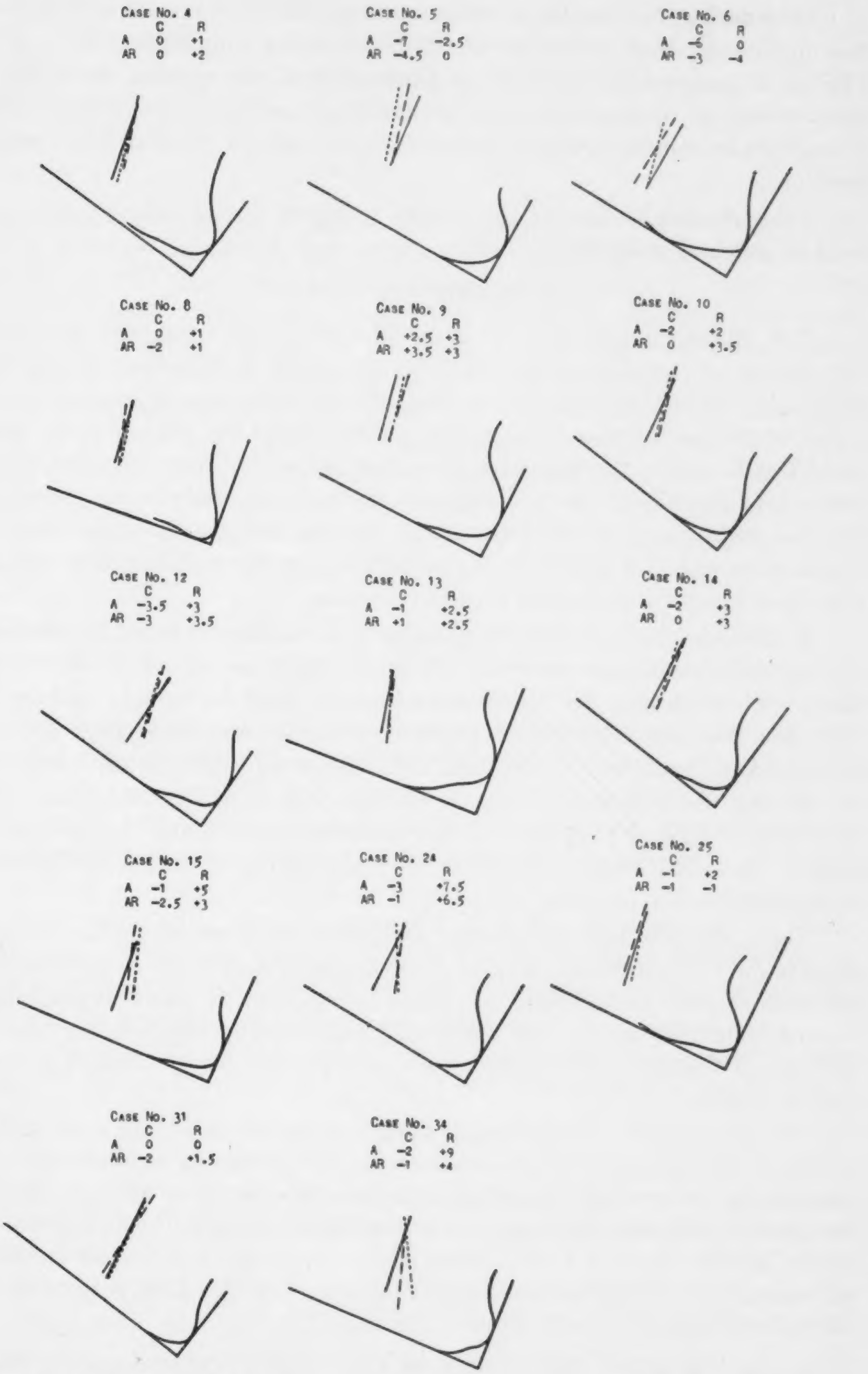


Fig. 7.—Tracings illustrating the movement of crowns and roots of the mandibular first molar before and after treatment and after retention. Prepared mandibular anchorage was the resistance factor employed. (Refer to Table X.)

———, Before treatment; *A*, after treatment (. . . .); *AR*, after retention (- - - -); *C*, crown; *R*, root apex; –, distal; +, mesial.

Considering the combined movements of the crowns and root apices of the mandibular first molars in the fourteen cases examined after treatment (Table X), more than one-half of these showed the crowns distal and the roots mesial to their positions before treatment, although the molars showed strong tendencies to upright themselves and return toward their previous positions.

After retention, most of the crowns were still distal and the roots mesial to their original positions.

DISCUSSION AND SUMMARY

This study employing serial cephalometric roentgenography to ascertain the degree of resistance derived from prepared mandibular anchorage, as taught by Tweed, Strang, Lewis, and others, demonstrates the mode of activity of the mandibular incisors and molars under the influence of Class III and Class II elastic therapy, as well as their behavior after treatment and subsequent to retention. Very significant in these movements are the changes in axial inclinations of the mandibular incisors, various linear movements of the crowns and root apices of the mandibular incisors and molars, and their seemingly inherent tendencies toward reversion.

A résumé of the abundant literature pertaining to axial inclination of the mandibular incisors serves particularly to focus attention on Tweed's[31] early contention that the mandibular incisors must be upright and on basal bone for the best results in resistance, stability, and esthetics. Margolis[18] translated this clinical observation into the incisor-mandibular plane angle by relating the long axis of the mandibular incisor to the mandibular plane. Downs,[8] Speidel and Stoner,[28] and Noyes, Rushing, and Sims,[22] by their comprehensive investigations, emphasized the importance of the axial inclination of the mandibular incisors.

There appears to be a general acceptance of a range approximating 90 degrees for the incisor-mandibular plane angle. Procumbency of the mandibular incisors after orthodontic treatment is regarded by many as contributing toward instability of the end result and unfavorable esthetics, together with inadequate function and an uncertain environment for the health of the investing tissues.

The preparation of mandibular anchorage in the thirty-six cases analyzed in this study appears to have been an important factor in establishing and maintaining an average incisor-mandibular plane angle of 88.7 degrees after treatment. Although averages are not always applicable to or acceptable in certain studies, there is a consistency with respect to these incisor-mandibular plane angles that warrants noting (Tables I, II, IV). This is illustrated by the following observations:

1. The fifteen cases studied in Table I with prepared mandibular anchorage and after Class II mechanics yielded an incisor-mandibular plane angle of 88.8 degrees.

2. The average incisor-mandibular plane angle in twenty-seven cases after treatment (Table II) was 89.3 degrees.

3. The average incisor-mandibular plane angle of fourteen cases after retention, as shown in Table IV, is 89.1 degrees. All cases were subjected to a Class II elastic pull for an average of eight months.

An examination of the behavior pattern of the mandibular incisors exhibits an average incisor-mandibular plane angle in all cases studied, before treatment, of 93.7 degrees. Before anchorage preparation, however, the incisor-mandibular plane angle may have either increased or decreased slightly, depending on whether or not there were spaces in the mandibular incisor segments. Most of the nonextraction cases in this study were malocclusions manifesting small spaces which were closed during the process of leveling for bracket engagement, thus uprighting the incisors slightly. After anchorage preparation, the incisor-mandibular plane angle was reduced to 81.5 degrees, showing the decrease from the original to be 12.2 degrees. This decrease in axial inclination was accomplished by a lingual tipping of the crown in every case (Table V) and labial tipping of the root to a slightly lesser degree.

During Class II mechanics the axial inclination of the mandibular incisors increased in almost every case and this greater incisor-mandibular plane angle was created by a labial movement of the crowns in almost all cases, indicating a movement of the crowns in the direction of the elastic force. Nevertheless, after Class II mechanics it is of utmost significance that almost all the crowns were the same or were still lingual to the positions they occupied before anchorage preparation, with the root apices showing a decided tendency to move lingually or back toward their original positions.

Following a period of retention (one to three years) the axial inclination of the mandibular incisors increased slightly, the final position being one in which we find the average axial inclination to be 89.1 degrees or 4.6 degrees more lingual than before treatment. The average crown was 2.6 mm. lingual and the average root apex 0.3 mm. lingual.

A general review of the typical movements of the mandibular incisors described in Tables I to VII, and Charts 1 to 6 is presented in the following summation:

1. In the short period before treatment and before anchorage preparation there may be a slight increase or decrease in the incisor—mandibular plane angle, depending upon the amount of spacing in the mandibular anterior segment.

2. After anchorage preparation there was a considerable decrease in the incisor-mandibular plane angle, with the crowns tipping lingually and the roots labially.

3. During Class II mechanics the crowns tipped labially and the root apices tipped lingually to a small degree.

4. At the completion of treatment we still find the crowns lingual and the roots labial to their original positions.

5. After retention the changes in axial inclination of the mandibular incisors denote a tendency to revert toward their original angles, but especially important is the fact that they were still less than when treatment began.

Evaluating the movements of the mandibular molars, we similarly find that after anchorage preparation most of the crowns moved distally, with approximately one-half of the roots moving mesially (Table VIII). During Class II mechanics, most of the molar crowns moved mesially but the roots showed a variety of movements, that is, mesial, distal, or no change.

After treatment the findings indicated that most of the crowns were still slightly distal to their original positions, with the great majority of roots mesial.

After retention most of the molar crowns tipped forward in a mesial direction, although practically all were still distal or showed no change from their initial positions. The root apices again exhibited a variety of movements divided between mesial, distal, and no change. Subsequent to retention, however, most root apices were still mesial to their original positions.

The same trend that was characteristic of the mandibular incisors also predominated with the molars, in which the tendency to revert was more prevalent with the crowns than with the roots.

Comparing the activities of the crowns and roots of the incisors and molars during the various stages of treatment, we find them to be approximately the same with the one exception in which the average final position of the molar roots was more forward than the original position, whereas the incisor roots were slightly lingual.

Twenty-four of the thirty cases represented in Table IX show that the molar crowns were either distal or no further forward than their original position, and since we have already seen that under the influence of Class II elastics the mandibular molars do move forward, we assume that during anchorage preparation the crowns of the mandibular molars were tipped distally an amount sufficient to compensate for the forward movement that occurred during Class II mechanics.

CONCLUSIONS

1. The findings in this study supply evidence that mandibular anchorage preparation is an effective means of resistance against the forward pull of Class II elastics. Hence, the terminal positions of the mandibular incisors and molar crowns need not be anterior to their original positions after treatment.

2. During the process of anchorage preparation, the axial inclination of the mandibular incisors can be reduced sufficiently to compensate for any subsequent forward movement resulting from Class II mechanics, with the final location of the mandibular incisors still lingual to their original positions one to three years after retention.

3. Mandibular anchorage preparation alone does not supplant the necessity for extraction of teeth where disparities exist between the amount of tooth material and available arch length.

4. An average increase of 7 degrees in the incisor-mandibular plane angle can be expected during Class II mechanics.

5. This study furnishes unmistakable evidence that there is a predisposition of the mandibular incisors and molars to revert *toward*, but not completely to, their original positions in a great percentage of cases.

6. For further studies in the evaluation of tooth movements, frequent profile roentgenograms taken at short intervals to differentiate more clearly between tooth movement as a result of treatment and normal growth changes are suggested.

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1909 WALNUT ST.

Orthodontic Profiles

FOREWORD

The name and achievements of Norman W. Kingsley have become legendary and are destined to stand the tests of time throughout the science and art of dentistry. In the wide range of modern progress in dentistry, orthodontics, cleft palate therapy, maxillofacial orthopedics, and dentofacial restorations there are many techniques whose origin is directly traceable to him.

While it is a privilege, not without honor, to review the career of Dr. Kingsley, such a review affords a rare opportunity to the earnest readers of these pages of the JOURNAL to receive inspiration, and so to *emulate his spirit* as to inject it as a philosophy into our own *everyday* lives, and into the channels of forthright progress in the inevitable, changing future of orthodontics.

Kingsley has been authentically accredited as "The Father of Modern Orthodontics" as well as one of the most generally versatile dentists and professional men of his period. He was an accomplished dentist, orthodontist, cleft palate therapist, dental orthopedist (in the creation of fracture splint principles which still carry his name), facial prosthetist, teacher, educator, leader, author, artist, sculptor, and inventor. Dentistry to him was an art, receiving the same consideration and talent that he devoted to his more purely cultural achievements.

Kingsley first received recognition for his work in constructing "obturators" for cleft palate defects. He wrote the first book on dental subjects that included orthodontics, and was the first dentist to accomplish successfully what is known as "jumping" a cross-bite. He was also the inventor of numerous instruments currently used in dental practice. Contemporary in his period were many of his friends, also among the immortal pioneers of dentistry, including:

James Truman (1826-1914): Educator
J. Foster Flagg (1828-1903): Amalgam
Wm. G. A. Bonwill (1833-1899): Prosthetic dentistry
F. J. S. Gorgas (1834-1914): Materia medica
G. V. Black (1836-1915): Dental anatomy and operative dentistry
S. C. Barnum (1838-1885): Rubber dam
N. S. Jenkins (1840-1919): Dental ceramics
M. H. Cryer (1840-1921): Oral surgery, anatomy of the head
S. D. Perry (1844-1911): Hammered gold and Perry separator
T. W. Brophy (1848-1928): Congenital orofacial surgery
W. D. Miller (1853-1907): Oral pathology and bacteriology
G. H. Wilson (1855-1922): Prosthetic dentistry
C. Edmund Kells (1856-1928): Dental roentgenology
Horace Wells (1844): Nitrous oxide gas

This is a supplemental list, not including many others.

In orthodontics prior to 1900 are to be found the illustrous names of N. W. Kingsley, J. N. Farrar, C. F. Delabarre, S. H. Guilford, E. H. Angle, Henry Baker, V. H. Jackson, F. A. Bogue, E. S. Talbot, C. S. Case, G. C. Ainsworth, C. S. Goddard, and C. W. McGill, those indomitable pioneers to whom orthodontics, in retrospect, owes so much recognition today.

NORMAN WILLIAMS KINGSLEY—A MAN OF GENIUS 1829-1913

NORMAN W. KINGSLEY was born on Oct. 2, 1829, in Stockholm, St. Lawrence County, in northern New York State. He was the son of Nathaniel and Eliza Kingsley, whose ancestors were among the early pioneers who immigrated to this country from England. In June, 1848, with his parents and six brothers and sisters, he moved to Bradford County, Pennsylvania. During the winter of 1848 he attended classes at Troy Academy, Troy, New York, and during the summer assisted his father on the farm. In the fall of 1849 he entered the office of his uncle, Dr. A. W. Kingsley of Elizabeth, New Jersey, and in 1852 opened his first office in Oswego, New York.

His fame soon reached New York City, and several prominent citizens persuaded him to move his office to that city, which he did. During the World's Fair held in New York in 1853 Kingsley exhibited several porcelain carvings of partial and full sets of teeth mounted on gold, for which he was awarded a gold medal. This was followed by similar exhibitions at the World's Fair held in Paris in 1855, for which he received several medals for his work.

In 1859 Kingsley developed an obturator with artificial velum of soft vulcanized rubber for cleft palate closure; this was received with great acclaim by both the dental and medical professions. His early recognition of the value of orthodontics resulted in his collecting all the material relating to the subject printed up to that time, and he standardized the methods of procedures in the first book to be published containing information on this advancing specialty of dentistry.

His fame spread throughout England; in 1864 he was invited as a special guest, and delivered lectures before the Odontological Society of Great Britain and the London Medical and Chirurgical Society.

As one of the founders of the New York College of Dentistry, now the New York University College of Dentistry, he served as its first dean for three years (1865-1868), and also as professor of dental art and mechanism. In 1871 he visited Baltimore, where the honorary degree of Doctor of Dental Surgery was conferred upon him by the Baltimore College of Dental Surgery. From 1869 to 1883 he served as a member of the Board of Trustees of the New York College of Dentistry.

For sixteen years he was president of the first New York State Board of Censors, now the Board of Dental Examiners, and was the first president

of the Dental Society of the State of New York and also of the District Society of New York City. Dr. Kingsley was a prolific writer and the *Index of Dental Periodical Literature* lists his authorship of over 100 articles. His most extensive writings were on the subjects of orthodontics and cleft palate prosthetic corrections and therapy.

SELF-PORTRAIT OF NORMAN WILLIAMS KINGSLEY

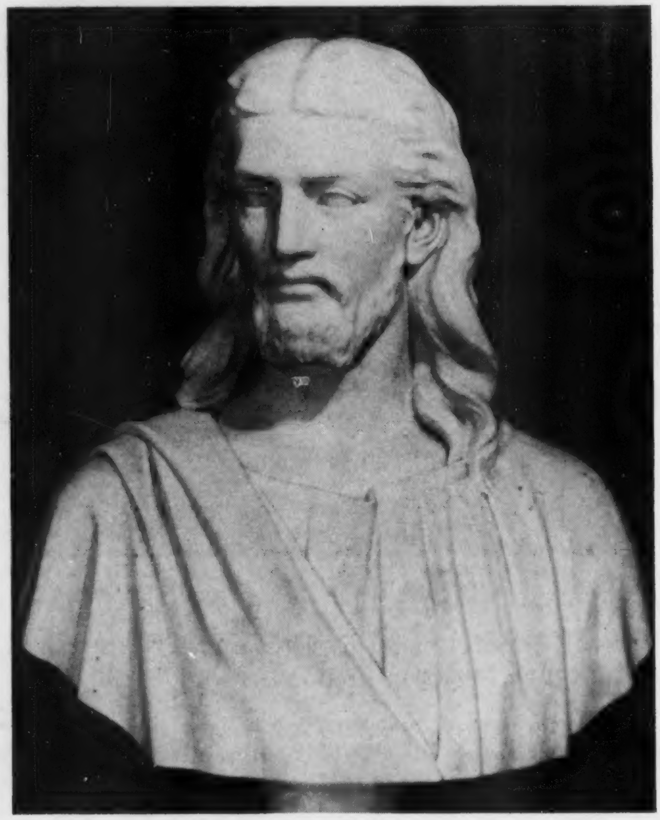
The sculpture of Christ created by Dr. Kingsley is referred to in Koch's *History of Dental Surgery* (Vol. 3) as follows:

Of all Dr. Kingsley's many attainments, the artistic side of his career is most interesting. His bust of Christ modeled in 1868 is probably his best effort. Art critics pronounce it the best piece of work of its kind ever done. Its inception and production was apparently inspirational. It is said that Dannecker attempted, with moderate success, to portray Christ as the mediator between God and man. Thorwaldsen's Christ is a more powerful conception, yet sacrificing the manliness of the Messiah in trying to bring out properly the loveliness of face and its character. Kingsley's bust combined both the manliness and gentleness that beautifies the life and character of the Master. It is a composite face of Greek, Roman, and Jew, intermingling the gentleness of woman, the manliness of man, and the sacredness of a saint.

It is recorded that Dr. Kingsley had worked in other media before he made his bust of Christ. He had engraved on copper and wood, painted in oils, embroidered on silk, and hammered brass and other metals into bas reliefs and shields. He had created busts and plaques in plaster of Paris and in all of these efforts demonstrated a natural ability and a skill to produce objects of outstanding artistic merit.

A bust of Christ by a distinguished sculptor of this period which he was permitted to observe during its modeling and which failed to interpret the Messiah as he visualized Him was the spark which touched off his creative genius.

It was while teaching a class in the New York College of Dentistry and trying to convey a sense of the artistic to the group that his ideas of the face of the Christ he wished to create began to take form and crystallize in his mind, so he felt that at last he could transfer his impressions into a tangible and concrete expression in substance. Inspired by the thought that at last he was somewhat prepared to proceed with the project, by which he had been haunted for several years, he modeled in clay his impressions and as the mass took form, working a few hours each evening, after the arduous duties of the deanship of the dental college, he finally had produced a Christ portrait of such wondrous beauty and perfection that all those to whom it was shown were at a loss for words to express their admiration of it.



KINGSLEY'S BUST OF CHRIST

Unfortunately Dr. Kingsley did not understand the necessity of arranging proper support within the substance of the clay to prevent its sagging and the morning after exhibiting it to a group of his colleagues, he came down to his studio only to find that the bust had collapsed, fallen to the floor and was ruined.

An individual of lesser moral fiber would have been crushed by this tragedy, but undaunted Dr. Kingsley immediately started to re-create his ideal. Unfortunately despite his belief that the original face was indelibly printed on his mind, his efforts failed to produce a duplicate. Finally he decided to abandon the attempt to bring the spiritual, inspired face, which had rewarded his first effort back into being again and to produce

instead a perfect man with a face developed along scientific lines with perfection of physical and intellectual form combined with tenderness, compassion, understanding and all of those most desirable human attributes which are associated always in our thinking with the Son of God.

This effort went forward and finally resulted in producing a bust of Christ which in his own words he describes as follows: "Neither Jew, nor Gentile, but rather my idea of a perfect man, going back to the original idea that prompted me in the college. I planned my Christ of heroic size in the model, because bulk, where the lines are graceful, is impressive and contributes to the idea of majesty. I gave him the head of the Caucasian, because I believed that the most pleasing and will be the dominant type of a homogenous race. I gave him the feature of a woman because I saw in women the best expression of heavenly attributes, mercy, loving kindness, gentleness and purity. I gave to Him the face of an angel, as I conceived the face of an angel might be in its benignity, and lastly I gave Him a brain development along recognized phrenological lines which, while avoiding a monstrosity, would be within the possibilities of human existence. I gave to Him the soft beard of a man of thirty, the uncut hair of the Nazarene, and the conventional draping of his locality and time. Thus was my Christ built, occupying daily hours of study and labor, from mid-winter until the first day of May, 1868. It was afterwards reproduced in marble, and the result is before the world, but it never has fulfilled my ideal."

Thus in his own words did Dr. Kingsley describe and evaluate his own work. That there was disappointment associated with his inability and failure to repeat his original creation is understandable; nevertheless that he did create a masterpiece, worthy of the skill of any of the old masters, is acknowledged by art critics of his period and up to and including those of today.

Dr. Kingsley's bust of Christ has been photographed and used by an eminent author, Dr. Howard Crosby, as a frontispiece to his book, *The Life of Christ*, after an extended search for the finest artistic effort extant. This in itself is a genuine tribute to Dr. Kingsley's effort and ability as a creator, sculptor and artist.

A bronze bust of Whitelaw Reid, which he modeled while Mr. Reid was ambassador to England, was presented to the Lotus Club of New York. His oil paintings were also works of art and brought him fame, not only in this country but also in Europe.

Dr. Kingsley died in Paterson, New Jersey, in his eighty-fourth year, and funeral services were held in New York City on Feb. 22, 1913, a final tribute to this world-famous dentist by his devoted friends and many of those who had found new worlds through his beneficent care. No more glowing tribute could be paid to Dr. Kingsley than that made in his own inimitable manner by Dr. Calvin S. Case, who in orthodontics and cleft palate therapy was a genius in his own right: "The longer orthodontia is practised, the more respect the author has for the general teachings enunciated forty years ago and published in his inestimable text by that most ingenious man of his day, Dr. Norman W. Kingsley."

These two great masters were both deeply involved with "the difficulties arising in certain conditions and the influences of natural laws which continue to engage *our most earnest endeavors,* often in the futile attempt at permanence in retention." They both were sticklers for intelligent instruction in the "art" of *speaking correctly,* as determined by the "ability and persevering determination of the pupil."

Dr. Kingsley's book was published in 1880, having required three years for completion. All the illustrations, over 350 in number, are hand drawn largely by Kingsley himself and converted into wood cuts. It is replete with numerous designs of all metal "fixed" orthodontic apparatus and many tissue-borne vulcanite appliances, the forerunners of the modern "Hawley" and other forms of passive and active mechanisms.

He dwelt at length on the subjects of "justifiable" and "unjustifiable" extraction of teeth and illustrated the appliances he used for that purpose. Part two of the text deals with "Palatine Defects," both congenital and those acquired through trauma or disease. For the immobilization of fractures he illustrates and describes a number of splint principles, such as the famous occipital anchorage for fractures of the maxilla as well as the cortical rim of the mandible for anchorage in certain elevated and depressed fractures of the lower jaw including loss of substance.

Noteworthy of outstanding recognition are his splints for the gradual reduction of displaced segments wherein fibrosis or partial union had occurred. Dr. Kingsley describes and illustrates numerous designs of external prostheses for the artificial replacement of noses, ears, eyes, and sections of the face. He refers to fracture splints used during the Civil War by dentists working in both the Union and Confederate armies. He describes and illustrates the same designs of bandages for the head and face that are used today, including the Barton, modified Barton, Gibson, four-tailed, and others. He also describes and illustrates a series of *superimposed profile charts* with angulations oriented similar to the cephalometric roentgenogram of today.

Thus is recorded the life and works of this great pioneer genius and progenitor, and his eternal bequest to posterity.

So when a great man dies,
For years beyond our ken
The Light he leaves behind him lies
Upon the paths of men.

Longfellow: "Charles Sumner"

NOTES

For the procurement of materials and information necessary for the preparation of this profile of Dr. Kingsley, grateful acknowledgment is made to the following friends for their enthusiastic and interested cooperation, without which this article could not have been written:

Miss Margaret Galey Palmer, Librarian, Thomas W. Evans Museum and Dental Institute, University of Pennsylvania, who cheerfully furnished information available in the library.

Dr. Paul V. Reid, Professor of Orthodontics, Dental Institute, University of Pennsylvania, for his cooperation with the Photographic Department of the University in making these original photographs of the bust of Christ and the self-portrait, both of which are mounted in the library.

Dr. Herbert K. Cooper, Director of the Lancaster Cleft Palate Clinic, for the loan of an authentic newspaper obituary published by the New York *American* at the time of

Dr. Kingsley's death. Dr. Cooper is a most enthusiastic student of Dr. Kingsley, from whose writings much of his own career has been inspired.

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Joseph D. Eby

Editorial

THE FIFTY-THIRD ANNUAL SESSION OF THE AMERICAN ASSOCIATION OF ORTHODONTISTS NEW ORLEANS, LOUISIANA MAY 12-15, 1957

THE largest attendance ever enrolled for a meeting of the American Association of Orthodontists was recorded in New Orleans this year. Attendance at the 1956 meeting in Boston totaled 1,131; the 1957 New Orleans total was 1,312.

This all adds up to the fact that the American Association of Orthodontists, which at one time had a membership of a mere handful, now numbers about 1,800 members and that the annual meeting is a tremendous gathering of one of the most vigorous and enthusiastic groups in all dentistry.

In extending greetings, President A. C. Broussard pointed out that the Program Committee had gone all out and that the cooperation of all his committees had been excellent indeed. Those who attended will attest to the fact that hard work and cooperation were necessary to bring about such a meeting. Things were well organized from the registration desk right through the entire meeting of four days' duration.

A new plan was introduced by the Program Committee this year. An informative pamphlet relative to the scientific program and related activities concerning the speakers, panelists, and synopses was printed and mailed out to the membership in advance of the meeting. It was thought by the Program Committee that in this way verbal introductions during the meeting might be held to the minimum. It was pointed out that members who were interested were expected to read the biographical sketches of the essayists in advance of the time when the program was actually presented to the Association.

The 1957 sessions started on May 13. The first morning was devoted to the subject of etiology and each speaker tried to coordinate his effort with others appearing in sequence on this part of the program.

Another innovation at the New Orleans meeting was the appearance of two panels on the formal program. Both panels were held on Thursday morning. One subject was "Patients and Parent Personality and Psychological

Problems." This panel was led by moderator William S. Smith of San Francisco, California. Another subject was "Office Procedures, Business Management, Office Location, Associations, and Partnerships" and the panel was led by Brooks Bell of Dallas, Texas. These panel discussions will be published later in the JOURNAL. The scientific program and the entertainment programs were excellent.

Much of the program and other features of the meeting will be published in detail at a later date.

The constitutional amendment providing for membership in the American Association of Orthodontists by formal preceptorship training was defeated at the first business session; however, the same subject was reconsidered after an overwhelming vote of the assembly "to reconsider" in the second business session. After the vote to reconsider was passed by a wide margin, and subsequent to considerable formal discussion, the preceptorship amendment was approved without a dissenting vote. The vote to reconsider the amendment was brought about by a motion by Dr. Howard Strange of Chicago, who made a formal written request of considerable length, stating that many felt that at the previous meeting they were voting *for* instead of against the amendment at the time the previous vote was taken. This situation obviously was a result of some parliamentary confusion and failure of the members to discuss the question fully previous to the vote. For the benefit of those who did not attend the second business session at New Orleans, stenographers' notes on this discussion will be published in the JOURNAL as soon as these notes are available.

The morning of the second day, May 14, was devoted to the topic of treatment, tied in with various age groups. In addition, there were reports of research and case report exhibits of the American Board of Orthodontics. There were conference rooms on case analysis and treatment plans, which were well arranged.

With the above plan in mind, the meeting got under way on Sunday evening with the big "Get-Acquainted Supper" for members, ladies, and guests. The very entertaining speaker was Harnett Kane, author of the best-selling book *Louisiana Hay Ride*. This affair, under the direction of Samuel D. Gore, Jr., and Nathan Gaston quickly revealed its popularity when about twice as many people showed up for the dinner as had previously made reservations. The attendance at this party was about 500.

The attendance at the President's Reception also was about 500. Attendance at the Golden Anniversary Luncheon was about 235 and at the Round-Table Luncheon about 500. Two hundred ladies went on the Walking Tour and 416 went on the Garden Tour.

In order that you may know the local committees who, under the leadership of President Broussard, were responsible for this great meeting a list of the local arrangements committees at New Orleans follows:

Local Arrangements Committees

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Samuel D. Gore, Chairman
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Earl R. McCallon, Jr.
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All in all, the meeting was one of the best in the history of the A. A. O. and, with the stage setting in one of the oldest and most colorful parts of America, it can be said to have been a great success.

OFFICERS ELECTED FOR THE ENSUING YEAR

President: Franklin A. Squires, White Plains, New York
President-Elect: C. Edward Martinek, Detroit, Michigan
Vice-President: George Siersma, Denver, Colorado
Secretary-Treasurer: Earl E. Shepard, St. Louis, Missouri

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*Appointed committees are not yet complete.

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Nathan G. Gaston, '60

Transactions of the Fifty-third Annual Meeting of the American Association of Orthodontists held in New Orleans, Louisiana, May 12 to 15, 1957, will be published in the August issue of the JOURNAL.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Dimensional Changes in the Human Head and Face in the Third Decade of Life. By Melvyn J. Baer. *Am. J. Phys. Anthropol.* **14**: 557-575, December, 1956.

This study is designed to analyze size changes taking place in the human head and face during the third decade of life. The nature of dimensional change in six anthropometric measurements is assessed by fitting curves mathematically to data on white male and female military personnel.

Hellman (1927) concluded, on the basis of his analysis of American Indian craniums, that the face continues to grow in height and width to "old age," with a subsequent diminution in size during senescence. Skulls were considered to represent individuals of old age when Hellman's stage VI of dental development had been attained, that is, when the grooves on the occlusal surfaces of the molar teeth were worn off.

Hooton and Dupertuis (1951) revealed increases in head circumference, head length, and bizygomatic diameter through 35 to 39 years, and increases for head breadth and total face height through 30 to 34 years.

The data used in this study are drawn from material collected in 1946 by the Army Anthropometric Survey, Office of the Quartermaster General. The male series comprises a population of 5,688 white, third-generation Americans (all four grandparents born in the United States) measured at Fort George G. Meade, Maryland. The female series consists of the total survey population of 7,420 white WACs and Army nurses, native born but not necessarily having all four grandparents American born. Both series were measured at the time of separation from military service. The age range was 19 through 33 years.

The dimensions selected for study were: head length, head breadth, head circumference, total face height, bizygomatic diameter, and nose height. In the female series only total face height is reported.

The data indicate that during the third decade of life the three facial dimensions of the male increase in size, while the three head dimensions do not change significantly in proportion. Face height and nose height exhibit a curvilinear pattern of slow deceleration, while bizygomatic diameter is characterized by slow linear increase.

Some investigators of craniofacial growth by roentgenography comment upon the constancy of facial proportions during various phases of occlusal development. Broadbent (1941) found that a proportional increase in the size of the segments of the face occurs after the deciduous dentition is completed. Brodie (1941), in discussing the growth of the nose, made the further generalization that "Whether one studies the newborn, the child of eight years or the

adult, this part always constitutes 43 per cent." For adult craniums of diverse origins, Herzberg and Holic (1943) also found that mean nose height comprised 43.51 per cent of facial height.

The fact that the data showed face height and nose height to increase long after completion of the permanent dentition suggested pressing the analysis of the data one step further. Accordingly, proportional relationships were explored in two ways: (1) calculation of mean nose height as a percentage of mean face height for each year and (2) analysis of the pattern of increase in the lower portion of the face (subnasale to menton).

While the face is increasing in size, nose height comprises a constant proportion of face height. This cannot be taken to mean that the growth rates of the components of the face are the same, or that the rates maintain a constant relationship. Indeed, the opposite is true. While nose height shows a pattern of slow, decelerating growth, the lower portion of the face undergoes slow, linear increase.

Results of the analysis of variance in women fail to warrant the conclusion that female face height increases in size appreciably during the early adult period. However, if a 10 per cent probability of error is accepted, it may be concluded that female face height tends toward a slight linear increase.

The findings for female face height contrast sharply with those obtained for face height in the male. The greater amount and duration of growth of the male face apparently represent a developmental sex difference.

While supporting the general conclusions of Hellman (1927), Hrdlička (1936), and Lasker (1953) that the human male face continues to increase in size after the adult period has been reached, the data on American military personnel show particular correspondence to the findings of Buchi (1950) on Swiss males and Hooton and Dupertuis (1951) on Irish males. For the age period from 19 through 33 years, the data for total face height are best represented by a decelerating curve approaching a plateau at the later ages. Bizygomatic diameter (face breadth), on the other hand, is characterized by a straight-line curve without suggestion of an approaching plateau. The difference in the patterns of increase of the two dimensions is reflected in the findings of Hooton and Dupertuis, in which total face height reached maximum size in the 30- to 34-year age group, while face breadth achieved maximum size in the 60- to 64-year age group. Correspondingly, Buchi found statistically significant increases in face height through his 38- to 47-year age group only, although face breadth showed significant increases through the 56- to 64-year age group. Thus, the combined weight of the evidence points to a pattern of size change in which, during the adult period, male face breadth undergoes a slower but more sustained increase than does total face height.

With regard to female face height, the present data lend little support to Hrdlička's contention that size increases take place through the fourth decade of life and possibly beyond, for the increase in female face height was found to be significant only at the 10 per cent level. Although Buchi found a statistically significant increase occurring in his 29- to 38-year female age group, his findings are similar to those of the present study in showing comparatively longer continuance of growth in face height in the male, that is, through the 38- to 47-year age group.

The area of greatest difference between the present series and other male series reported in the literature concerns changes in the three head dimensions of length, breadth, and circumference during the adult period. Analysis of these dimensions in the present series showed no significant increase during

the third decade of life, while findings for other series range from statistically significant increases through the fifth decade of life to rather indeterminate results suggesting increases in some dimensions but not in others.

The investigator reporting anthropometric data showing age changes in adult body dimensions is often hard pressed to demonstrate a specific cause for these changes. Morant (1947), Randall (1949), Hooton and Dupertuis (1951), and Lasker (1953) have discussed the need for recognizing at least three factors, each of which conceivably could be responsible for changing the dimensional age norms of an adult population. These factors are secular change, selective survival, and ontogenetic development. Secular change, it is hypothesized, would result in size differences between two generations of the same population, and possibly even in persons born a few years apart. Selective survival, it is further hypothesized, would eliminate individuals of less favorable body size or body proportions at correspondingly younger ages, thereby creating size differences within the population when the members are arranged by age. Ontogenetic development is usually regarded as a two-faceted phenomenon in age change studies; that is, such items as gains in fatty tissue with increasing maturity are distinguished from what is considered to be "true growth," actually bony growth.

These studies reveal that the human cranium undergoes an early rapid expansion in conjunction with the growth of the brain, while the face shows sustained growth of longer duration, related to the development of dental occlusion. They show, further, that females achieve their greatest gain in facial growth earlier than males and tend to be about one dental stage in advance of males during the period of mixed dentition. The continued growth of the male face into young adulthood, then, represents the terminal phase of the childhood pattern.

The face does not stop growing at an identical age in all individuals. Again, if certain developmental patterns are found to result in some individuals manifesting greater survival potential than others in the population, this fact, too, is made amenable to analysis by the longitudinal approach.

Turning more specifically to the study of the adult face, the use of roentgenographic techniques will permit a better delimitation of the segments undergoing increase than is possible with surface measurements. Weinmann and Sicher (1947), on the basis of histologic data, state that growth continues at the fundus of the tooth and at the free margin of the alveolar process. Studies of the type conducted by Broadbent (1937) and Brodie (1941), if extended to cover the adult period, could test and quantify the leads coming from both anthropometric surveys and comparative histologic analyses. For example, the increase reported here as occurring in the anterior height of the adult face (total face height), and reported in the literature for other populations, must involve correlated size changes in other facial segments. It is difficult to conceive of an increase taking place in anterior face height without postulating a parallel increase in the height of the ramus of the mandible, for such a condition would result in a progressively open-bite and a changing occlusal relationship.

These findings are reported: (1) Male total face height, nose height, and bizygomatic diameter show significant size increases during the third decade of life; during the same period head length, head breadth, and head circumference do not significantly change with age. (2) In the third decade of life female face height does not show a size increase comparable to that occurring in the male. (3) The greater amount and duration of growth in the male face in the third decade apparently represent a developmental sex difference.

News and Notes

Meeting of the American Board of Orthodontics

The American Board of Orthodontics held its annual five-day meeting May 7 through 11, 1957, for the purpose of conducting routine business and in order to examine candidates aspiring to certification.

The unanimous choice for the new director to be appointed to the Board was Dr. Frank P. Bowyer of Knoxville, Tennessee. Dr. Bowyer replaces Dr. Ernest L. Johnson, whose seven-year term of office expired at the time of the New Orleans meeting and who served as president of the Board during his final year of service and as vice-president the year before.

In the final session the Board adopted by acclamation the following tribute:

> "In the closing moments of the official session for 1957, the directors wish to express to the retiring president, Dr. Ernest L. Johnson, appreciation for his years of devoted service to the American Board of Orthodontics. During his membership on the Board he was responsible for introducing additional methods to be used in examining candidates by the analysis of practical cases, which

The American Board of Orthodontics for 1957. This photograph was taken at the Roosevelt Hotel in New Orleans, Louisiana, in May, 1957.

Front row: Wendell L. Wylie, Secretary, San Francisco, California; Ernest L. Johnson, President, San Francisco, California; Lowrie J. Porter, Vice-President, New York, New York.

Back row: B. F. Dewel, Evanston, Illinois; J. A. Salzmann, Treasurer, New York, New York; William R. Humphrey, Denver, Colorado; and L. Bodine Higley, Chapel Hill, North Carolina.

has been found to be of great value. His fairness in examining candidates during his tenure on the Board and during the past year as president of the Board in the conduct of its meetings, in which he allowed full expression to all the directors, is greatly appreciated. The respect and regard which the members of the orthodontic specialty have for him in his own section of the country may be gathered from the increase in the number of applicants from the western part of the United States who applied for certification. He and his gracious wife, Mrs. Johnson, contributed greatly at all times to the social integration of the Board, which made the task of all of us much happier. We extend our thanks to him at this time, with the knowledge and appreciation that we have gained a great and true friend, and we wish him continued success in all his undertakings in the future."

Certification was granted to twenty-seven candidates, as follows:

Arthur S. Ash
Bert Ballin
Daniel Blatman
Dayton G. Blume
Martin Blumenfeld
Marvin A. Bregman
William Robert Campbell
Richard Cline
Melvin I. Cohen
Roy B. Dean
Ulysses Erdreich
Walter Harris Fordham, Jr.
Woodrow J. Frankel
Jerome H. Green
James M. Keenan
Sanford N. Kingsly
John T. Lindquist
Francis John Loughlin
Warren Robert Mayne
George Henry Parrot, Jr.
Frank Paulich
Robert Paul Posner
Irving Bernard Ross
Melvin V. Saxman
Bernard H. Schanbam
Stanley L. Wein
Eugene Edward West

American Board of Orthodontics

The next meeting of the American Board of Orthodontics will be held at the Commodore Hotel in New York, New York, April 22 through 26, 1958. Orthodontists who desire to be certified by the Board may obtain application blanks from the Secretary, Dr. Wendell L. Wylie, University of California School of Dentistry, The Medical Center, San Francisco 22, California.

Applications for acceptance at the New York meeting, leading to stipulation of examination requirements for the following year, must be filed before March 1, 1958. To be eligible, an applicant must have been an *active* member of the American Association of Orthodontists for at least two years.

Central Section of the American Association of Orthodontists

The next meeting of the Central Section of the American Association of Orthodontists will be held Sept. 23 and 24, 1957, at the Hotel Nicollet, Minneapolis, Minnesota.

Great Lakes Society of Orthodontists

The twenty-eighth annual meeting of the Great Lakes Society of Orthodontists will be held at the Hotel Statler, Detroit, Michigan, Oct. 20 through 23, 1957.

Orthodontists and students desiring to attend may make reservations directly through the Hotel Statler. Tickets for social functions may be procured from Dr. James Reynolds, Adrian, Michigan.

H. Irving Miller,
Program Chairman

Middle Atlantic Society of Orthodontists

The next annual meeting of the Middle Atlantic Society of Orthodontists will be held at the Warwick Hotel, Philadelphia, Pennsylvania, Oct. 20 through Oct. 22, 1957.

Northeastern Society of Orthodontists

The fall meeting of the Northeastern Society of Orthodontists will be held at the Hotel Statler, Buffalo, New York, Oct. 21 and 22, 1957.

Southern Society of Orthodontists

The thirty-sixth annual meeting of the Southern Society of Orthodontists will be held at the Eden Rock Hotel, Miami Beach, Florida, Oct. 27 through Oct. 30, 1957. Reservations may be made by writing direct to the hotel.

Southwestern Society of Orthodontists

The next meeting of the Southwestern Society of Orthodontists will be held Sept. 29 through Oct. 2, 1957, at the Baker Hotel in Dallas, Texas.

Denver Summer Seminar

The Board of Trustees of the Denver Summer Seminar have arranged the following program, to be presented at the annual meeting which will be held Aug. 4 through Aug. 9, 1957, at Writer's Manor:

Opportunities for Fortune Building Under Free Enterprise. Robert E. Moyers, D.D.S., Ph.D., Professor and Head, Orthodontic Department, University of Michigan, and Allen S. Richardson, lecturer in finance at the University of Denver.

Application of Cephalometrics in Field of Dentistry. Robert M. Ricketts, D.D.S., M.S., Pacific Palisades, California.

Diagnosis and Treatment of Cleft Palate Conditions. Robert M. Ricketts.

Evaluation of Functional and Esthetic Balance and Harmony in Orthodontic Case Planning. Robert M. Ricketts.

Utah-Tweed Orthodontic Seminar: Step-by-Step Procedure for the Correction of Malocclusions Using the Angulated Bracket Technique and the Edgewise Appliance.

Entertainment includes the annual supper on the evening of August 4 for members of the Seminar only. Members of the twentieth annual meeting and their families will enjoy famous old Central City and the attractions of the Teller House for dinner, followed by an evening at the opera.

The dates and other pertinent information will be mailed upon completion of necessary arrangements by your Board of Trustees.

Please make hotel reservations directly with Mr. Bob Casey of Writer's Manor, 1730 South Colorado Blvd., Denver, Colorado.

Programs will be sent direct to applicants. Applications are limited and will be given preference in the order of the dates application is made at the Writer's Manor.

Officers of the Denver Summer Meeting are:

Victor J. Benton, President
Wichita, Kansas

William B. Stevenson, Vice-President
Amarillo, Texas

Earl C. Bean
St. Louis, Missouri

H. Carlyle Pollock, Secretary
915 So. Colorado Blvd., Denver 22, Colorado

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J. Allen Langenfeld
Centralia, Illinois

Russell Winston
Houston, Texas

Benno Edward Lischer Honored

Dr. Lischer, well-known author and orthodontist, received the following citation from Washington University on Feb. 20, 1957:

> "To Benno Edward Lischer, Dean Emeritus of the School of Dentistry, in recognition of more than half a century of superior teaching and educational administration, in recognition of his tremendous personal leadership in the field of dentistry through local, national and international organizations, and in recognition of the many significant honors that have been bestowed upon him, this award is respectfully presented by the Alumni of Washington University."

Dean Lischer was presented with a beautiful silver tray on which was engraved:

Alumni Federation of Washington University
Annual Award
Presented to
Benno E. Lischer
In Recognition by Past Students of the High Place
He Holds in Their Esteem
February 20, 1957

Harvard School of Dental Medicine

Selection of five dental school graduates for the first postdoctoral study program in dental medicine, which opens next fall at the Harvard School of Dental Medicine, is announced by Dr. Roy O. Greep, Dean of the School.

The scholars come from four states. Two are from Connecticut and one each is from California, Maine, and Massachusetts.

Those selected, as announced by Dr. Greep, are: Charles Richmond Cushing, 2 West Broadway, Bangor, Maine; Richard Charles Grossman, 1336A So. Beverly Glen Dr., Beverly Hills, California; Lief B. Johannessen, 1455 Central Ave., Needham, Massachusetts; Herbert Wells, 45 Roger White Dr., New Haven Connecticut; and S. Jerome Zackin, 96 Stephana Lane, Waterbury, Connecticut.

For the next three years, as postdoctoral students, they will engage in a program, involving patient care, teaching, and research, especially designed to broaden their professional experience by developing additional competence in research, gaining teaching experience, and increasing their proficiency in the care of patients.

The postdoctoral program will be under the immediate direction of Dr. Reidar F. Sognnaes, Professor of Oral Pathology at Harvard. It will be conducted in collaboration with the basic science departments of the Harvard Medical School and with affiliated dental clinics at the Forsyth Dental Infirmary for Children, Children's Hospital, and the Massachusetts General Hospital.

The Harvard program reflects the thought of the School of Dental Medicine that present internships, research fellowships, or teaching fellowships, which are on a one-year basis, do not alone fully capitalize on the opportunity for postdoctoral education in dentistry which can be made available through Harvard University.

Dr. Greep commented that after completion of the one-year postdoctoral courses there has been increased activity on the part of those from the Harvard School of Dental Medicine to take more active roles in national and international scientific meetings with regard to both basic research presentations and clinical demonstrations.

Postdoctoral education in dental medicine also serves a need frequently expressed by School of Dental Medicine graduates, Dr. Greep noted, to pursue further clinical and research work which has been started or conceived in undergraduate years.

The three-year postdoctoral program to be launched next fall will further expand these activities in addition to stimulating the teaching capabilities of the participants.

Illustrative of the role played by graduates of the Harvard School of Dental Medicine since the first class was graduated in 1946, Dr. Greep pointed out, are twenty graduates who are at present serving in full-time or part-time teaching activities within the School and its affiliated hospital dental clinics. They hold appointments as assistants, fellows, instructors, and associates in various fields of dentistry.

The School has also attracted a number of scientists from abroad, Dr. Greep said, who have spent various lengths of time investigating special research problems in collaboration with the staff of the School of Dental Medicine. Four of these now hold professorial posts abroad in the fields of biochemistry, pathology, and zoology.

The postdoctoral study program at Harvard is supported by a five-year training grant from the United States Public Health Service.

Biographical material on those selected for a three-year postdoctoral study program at the Harvard School of Dental Medicine.

CHARLES RICHMOND CUSHING, 2 West Broadway, Bangor, Maine. Born Oct. 18, 1931. Attended the University of Maine; D.M.D. degree, Harvard School of Dental Medicine, 1957.

RICHARD CHARLES GROSSMAN, 1336A South Beverly Glen Dr., Beverly Hills, California. Born Jan. 3, 1932. B.A. degree, University of California at Los Angeles, 1953; D.M.D. degree, Harvard School of Dental Medicine, 1957.

LEIF BERTRAM JOHANNESSEN, 1455 Central Ave., Needham, Massachusetts. Born Aug. 25, 1925, in Norway. D.M.D. degree, Tufts University School of Dental Medicine, 1949. Director, Public Health Pedodontic Service, Tromsdalen, Norway, 1949-50; Intern (1951-52), Clinical Fellow (1952-53), and Assistant, Central Clinic (1955-), Forsyth Dental Infirmary for Children; Chief, Hospital Dental Service, Ft. Devens Hospital (1953-55); currently Visiting Dentist, Perkins School for the Blind and Member of the Visiting Staff, Glover Memorial Hospital, and private practice. Lieutenant, Royal Norwegian Navy (1950-51).

HERBERT WELLS, 45 Roger White Dr., New Haven, Connecticut. Born July 27, 1930. B.A. degree from Yale University, 1952; D.M.D. degree from Harvard School of Dental Medicine, 1956.

S. JEROME ZACKIN, 96 Stephana Lane, Waterbury, Connecticut. Born May 10, 1932. B.A. degree from Wesleyan University, 1953; D.M.D., Harvard School of Dental Medicine, 1957.

Lenox Hill Hospital

The expansion program at Lenox Hill Hospital gives an opportunity for three additional applicants in the orthodontic clinic. All applications should be addressed to Dr. Fred Squier Dunn, Chief of the Dental Clinic, 111 East 76 St., New York, New York. These should state postgraduate education and number of years in practice of orthodontics (whether it be exclusively or not). Membership in the Northeastern Society of Orthodontists is essential.

Societe Belge d'Orthopedie Dento-Facial

The orthodontists of Belgium have founded the "Societe Belge d'Orthopedie Dento-Facial" in Brussels, Belgium. The officers are:

President, Lucien De Coster
Secretary, Paul Biot
Treasurer, Pierre Speileux
Members: André Bieurge, Albert Reychler, and André Thibaut

American Institute of Dental Medicine

The next annual meeting of the Institute will take place at The Oasis Hotel, Palm Springs, California, Oct. 13 to 17, 1957. The faculty will consist of:

Dr. Edwin F. Alston, Clinical Instructor in Psychiatry at the University of California Medical School, who, because of the close relationship of many psychiatric and psychologic problems to dental practice, will present a series of lectures in this field.

Dr. S. J. Kreshover, Associate Director of the National Institute of Dental Research in charge of intramural dental research, will discuss selected subjects in the field of general and oral pathology.

Dr. K. F. Meyer, Director Emeritus of the Hooper Foundation for Medical Research, University of California, will discuss the exciting story of polio vaccine, as well as the advancement of scientific research in Russia.

Dr. Max S. Sadove, Professor of Surgery, University of Illinois, has been highly recommended for his expert knowledge in the field of anesthesiology. He will correlate the various aspects of this subject to the practice of dentistry.

Dr. Joseph F. Volker, Dean of the School of Dentistry of Alabama University, has agreed to speak about caries and fluoride and dental health.

There will also be presentations by three of the younger research workers in the Division of Oral Biology, School of Dentistry, University of California, who are actively engaged in clinical and laboratory investigations: Drs. Sol Silverman, Theodore Grant, and Howard Myers.

All Seminar lecturers will participate in an open forum, discussing the application of their subject to the practice of dentistry. Because of the mounting interest in this annual meeting of the Institute, early registration is requested.

The Institute also calls attention to the Case History Service which is furnishing dental medicine case histories with Kodachrome slides, medical history, laboratory findings, roentgenograms, and all data pertaining to each individual case.

Applications and full information concerning either the annual meeting or the Case History Service may be secured from the Executive Secretary, Miss Marion G. Lewis, 2240 Channing Way, Berkeley 4, Calif.

American Dental Association

The ninety-eighth annual session of the American Dental Association will be held in Miami-Miami Beach, Florida, Nov. 4 to 7, 1957.

European Orthodontic Society

The next meeting of the European Orthodontic Society will take place Aug. 29 to Sept. 2, 1957, in Stockholm, Sweden. Interesting papers have already been announced by orthodontists from the United States, Israel, and all countries of Europe. Simultaneous translation will make comprehension of all conferences easy.

All inquiries may be addressed to the president of the European Orthodontic Society: Professeur E. Fernex, 1 place du Port, Geneve, Suisse.

Féderation Dentaire Internationale
Twelfth International Dental Congress

The twelfth International Dental Congress will be held at the Congress building of the E. U. R. in Rome, Italy, Sept. 7 to 14, 1957.

The scientific program consists of twenty-five reports and 150 co-reports covering all fields of dentistry, including anatomy and physiology, anesthesia and surgery, caries and protective therapy, periodontal diseases, radiology, prosthesis, dento-maxillo orthopedics, and social dentistry. Before Sept. 7, 1957, all reports will be published in English, with a summary in French, German, Italian, and Spanish, in the *International Dental Journal* and in Italian in the *Rivista Italiana di Stomatologia.* In their September and October issues both journals have already published the reports of J. P. Walsh (Otago, New Zealand), J. G. de Boer (Groningen, Netherlands), J. A. Salzmann (New York), C. G. Paffenbarger (Washington), H. H. Stones and F. A. Lawton (Liverpool), and E. Müller (Hamburg, Germany).

By means of simultaneous translations, Congress members will be enabled to hear the reports, co-reports, and discussions in the five official languages—English, French, German, Italian, and Spanish.

Notes of Interest

Arthur H. Craven, D.D.S., M.S., announces the opening of his office at 903 East Grand River Ave., East Lansing, Michigan, practice limited to orthodontics.

Rudolph A. Martin, D.D.S., announces the opening of his office at 30 Liberty Street Extension, Painesville, Ohio, practice limited to orthodontics.

Wallace J. Morlock, D.D.S., announces his association in the practice of orthodontics with Dr. Robert E. Baker, 828 Lowry Medical Arts Bldg., St. Paul, Minnesota.

George J. Muench, D.D.S., announces the opening of his suburban office for the practice of orthodontics at 169 Hobart Ave., Short Hills, New Jersey.

OFFICERS OF ORTHODONTIC SOCIETIES

The AMERICAN JOURNAL OF ORTHODONTICS is the official publication of the American Association of Orthodontists and the following component societies. The editorial board of the AMERICAN JOURNAL OF ORTHODONTICS is composed of a representative of each one of the component societies of the American Association of Orthodontists.

American Association of Orthodontists

President, A. C. Broussard - - - - - - - - - Maison Blanche Bldg., New Orleans, La.
President-Elect, Franklin A. Squires - - - - - - - - Medical Centre, White Plains, N. Y.
Vice-President, William B. Stevenson - - - - - - - - 610 West 8th St., Amarillo, Texas
Secretary-Treasurer, Earl E. Shepard - - - - - - - - - - - 8230 Forsyth, St. Louis, Mo.

Central Section of the American Association of Orthodontists

President, Thomas D. Speidel - - - - - - - - - - University of Minnesota Dental School, Minneapolis, Minn.
Secretary-Treasurer, William F. Ford - - - - - - - - - - 575 Lincoln Ave., Winnetka, Ill.

Great Lakes Society of Orthodontists

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